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Effectiveness of Safety Belt Use Laws:

A Multinational Examination

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PREFACE

In early 1984, the Steering Committee of the OECD Road Research Program initiated a project to examine the effectiveness of safety belt use laws. The project was organized to learn whether the experience of the many nations that have enacted safety belt use laws was transferable. The project working group was hoping to gather sufficient information so that all could benefit from the collective experience with these laws. The results of this project indicate that safety belt use laws are an effective way to reduce highway casualties. However, it remains to be seen whether the experiences of the nations that participated in this project are transferable.

In September 1984, a questionnaire on safety belt use laws was sent to approximately twenty-five nations, of which more than twenty responded. Using this material in conjunction with the existing literature, members of the working group wrote a series of papers analyzing various aspects of safety belt use laws.

In November 1985, more than eighty experts from fourteen nations met in Washington, D.C., to participate in a workshop on the effectiveness of safety belt use laws. The workshop was structured around the papers prepared by the working group members. Each session of the workshop consisted of one or more presentations by members of the working group followed by prepared comments of selected workshop participants. Finally, the entire workshop discussed each of the issues raised.

This volume includes a summary of the Washington workshop and the final version of the papers authored by working group members that were presented.

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WORKSHOP SUMMARY

EFFECTIVENESS OF SAFETY BELT USE LAWS: A MULTI-NATIONAL EXAMINATION

On November 12-14, 1985, more than eighty experts from fourteen nations met in Washington, D.C., and participated in an OECD Workshop on the "Effectiveness of Safety Belt Use Laws: A Multi-National Examination." This workshop was the culmination of an 18-month long project sponsored by the Organization for Economic Cooperation and Development's (OECD) Road Research Program.

The project was designed to collect recent data on safety belt use laws within the OECD member countries and produce, to the degree possible, a comparative assessment of those laws. The goal of the project was to provide information that would enable program administrators to improve the effectiveness of safety belt use programs.

This project clearly indicates that laws to require the use of safety belts do, in fact, reduce highway casualties. However, more research and evaluation are desirable since there was surprisingly little data available on a number of programmatic issues. The absence of this information makes it unclear whether the experiences of the nations that participated in this study are transferable in every instance.

The workshop was organized around analyses of data provided in response to an OECD questionnaire. The questionnaire solicited information on many aspects of safety belt use laws. Information describing the laws and belt use programs in support of the laws was provided. Data on belt use levels and on changes in casualties were sought. Finally, material on child restraint programs and belt use in the rear seat was solicited.

Working papers in each of these areas were prepared and the workshop was organized around their presentation. Each session had one or more working papers presented followed by prepared discussions by a number of workshop participants. The workshop then turned to a discussion of issues involving all participants.

The four formal sessions covered (1) safety belt use laws, (2) safety belt use rates, (3) casualty reductions resulting from safety belt use laws and (4) rear seat belt use and child restraints. The workshop closed with a summary of each of the sessions and a discussion of a research agenda on safety belt use issues.

SESSION 1: Safety Belt Use Laws

Session 1 began with Tore Vaaje's presentation on safety belt use laws. Virtually all of the OECD nations recognize the need for safety belt use laws. As of November 1985, laws requiring safety belt use by front seat passenger car occupants had been enacted in all or part of 17 OECD nations. Safety belt use laws had been enacted in all eight Australian states, eight of ten Canadian provinces and sixteen of fifty U.S. states. (Due to the timing of the OECD project, data are only included on Michigan, New Jersey and New York.)

Vaaje's comparative assessment of belt use laws within the OECD nations found that most incorporate meaningful sanctions and consistent enforcement. Further, public information on safety belt use is an important activity in all of the OECD nations with laws.

In almost all jurisdictions with laws, all road systems are covered. However, the vehicles and seating positions covered vary. Six jurisdictions' laws covered cars only, seventeen included wagons and vans, and an additional ten covered all vehicles with belts installed. More than half the jurisdictions required safety belt use only in the front seat. Finally, most jurisdictions permit exemptions from the law for medical reasons, for children, and for various classes of commercial drivers.

Every jurisdiction with a law eventually imposed a fine for failure to comply with use laws. There is some evidence that a law without fines is far less effective than a law with fines, although it was not possible to assess whether the size of the penalty was of particular importance. While the potential fines ranged from under $5 (U.S.) to more than $1,300 (U.S.), the distribution of the most frequently imposed fines was much narrower:

6 jurisdictions impose normal fines below $10
14 jurisdictions impose normal fines between $10 and $20
5 jurisdictions impose normal fines between $20 and $30 and
6 jurisdictions impose normal fines in excess of $30.

Further, nineteen jurisdictions permit reductions in insurance compensation to unbelted accident victims.

In all jurisdictions responding, enforcement of safety belt use laws is the responsibility of those police agencies charged with traffic enforcement functions. More than 75% of the jurisdictions permit direct enforcement of the laws, in which a citation is issued independently of any other traffic law violation. In addition, approximately half the jurisdictions permit warning tickets to be issued.

Vaaje was able to determine the proportion of all traffic tickets that were issued for non-compliance with belt use laws in nineteen jurisdictions. They ranged from 1% to 18%, distributed as follows:

less than 5% - 6 jurisdictions
between 5 and 10% - 9 jurisdictions
above 10% - 4 jurisdictions

Every jurisdiction reported programs in place to educate the public in conjunction with use laws. However, it was not possible to compare these programs. Vaaje did conclude that a belt use law alone is not sufficient to generate high belt use levels. It must be accompanied by sanctions, enforcement and public education.

The three prepared discussants, P. Milne, Australia; H. Warnke, Germany; and E. Petrucelli, U.S.A.; generally agreed with Vaaje's conclusions.

Milne described a recent public education campaign focusing on rear seat belt use. The Australian State of Victoria required belt use by both front seat and rear seat occupants. This campaign succeeded in raising rear seat belt use from 40% to 80%, evidence that public education can be effective. Milne also pointed out that a single police force in each Australian state makes coordinated enforcement and public education campaigns very efficient. The Australian experience has relied upon consistent enforcement, with tickets issued for failure to comply with belt use laws being second in number only to speeding tickets.

Warnke stressed continuous public education as the essential ingredient in making laws work. He contended that the German experience showed that the presence of a fine was important. He believed that the initial absence of a fine in Germany convinced large numbers of people that the law was not compulsory -- a fact that was remedied when fines were introduced. But he did not believe that the level of the fine or the intensity of enforcement were critical to the successful implementation of the law.

Warnke raised two issues that were never satisfactorily resolved at the workshop. First, while there was much discussion about public information, there were no consistent definitions of what this meant or how to quantify it. Thus, comparative assessments of the importance of public information as part of safety belt use law implementation could not be developed. Second, Warnke contended that cultural differences played an important part in the effectiveness of belt use laws. While there were differences of opinion regarding this issue, the absence of quantitative data on public information left this as an unresolved issue.

Petrucelli described the recent experience in New York, the first U.S. state to enact a belt use law. She agreed with Vaaje's conclusion that enforcement and public education must go forward in conjunction with any law. Further, she believed that targeting public information to various groups, such as the elderly or teenagers, was important. She believed that any public information program must stress enforcement, as the perception of enforcement may be more important than the actual level of enforcement. Finally, she believed it critical to evaluate carefully the effect of belt use laws, particularly using hospital data to examine changing patterns of injury.

Many of these issues were covered in the discussion that followed. Generally, direct enforcement was considered to be an important component of a law and concern was expressed that secondary enforcement (where a citation may be issued only in conjunction with another traffic violation) could potentially undermine the effectiveness of a law. The workshop participants agreed that the essential ingredients of a successful safety belt use law are (a) the availability of well designed safety belts, (b) a clear, simple safety belt use law and (c) a commitment to enforce the law. Further, this commitment must be accompanied by public education and publicity. Finally, the workshop concluded that complex and widespread exemptions under the law could undermine the effectiveness of a belt use program.

SESSION 2: Safety Belt Use Rates

Session 2 began with working paper presentations by E. A. Marburger, Germany; and J. Lawson, Canada. Marburger reviewed continental European countries while Lawson reviewed countries of the British Isles, North America, Australia and New Zealand. These presentations addressed a number of issues. First and most important was a systematic assessment of what had happened to belt use levels after the enactment of safety belt use laws. Second was the impact, if any, of demographic factors and other characteristics of road users on belt use levels. Finally, both presentations reviewed belt use survey techniques in the OECD nations.

Marburger reported that for the jurisdictions whose data he analyzed, belt use increased by 40 to 65 percentage points -- more than doubling previous usage in most cases. Lawson, while also reporting large increases in belt use, documented more of a bimodal distribution with Canada and Ireland showing increases between 30 and 40 percentage points and Australia, New Zealand and the United Kingdom showing increases of between 60 and 70 percentage points.

When the experience of these countries was examined in more depth, a number of factors of interest were discovered.

First, there was no consistent pattern with respect to whether there was a decline in belt use following the initial increase in usage after the enactment of a law. In virtually every jurisdiction, belt use showed a substantial increase following enactment of a law. However, while a number of jurisdictions were able to sustain usage at these high levels, other jurisdictions experienced a significant decay in usage after the initial increase. It was not possible to determine why these different patterns occurred, although it is important to note that even in jurisdictions that experienced a decline in use levels, there still was a significant increase in belt use compared with the pre-law period.

Second, when both Marburger and Lawson examined safety belt use at night, they also found mixed results. In some jurisdictions there was no appreciable difference between daytime and nighttime belt use. In other jurisdictions, nighttime belt use was as much as twenty percentage points lower than daytime use. Jurisdictions with the highest belt use rates had the smallest difference between day and night belt use.

The final item of interest was an indication that safety belt misuse was a common problem. Many instances of belt misrouting or the introduction of too much slack were found in selected studies in a number of countries.

Both Marburger and Lawson developed data on a wide variety of demographic variables and other road user characteristics. They were generally consistent but were considered of limited utility as predictors of belt use. However, some of the variables were quite useful in the development of countermeasures. For example, married people and women buckle up more frequently than average. Usage is higher among groups with more education. High risk groups use safety belts less frequently. One interesting item developed by Marburger was that belt use varied significantly between the German speaking, French speaking and Italian speaking sections of Switzerland. Marburger also noted differences in belt use by road type and land use, suggesting that belt use surveys must control for vehicle miles travelled (VMT) if they are to produce comparable results from jurisdiction to jurisdiction.

Among the OECD nations, the principal means for determining the level of safety belt use is roadside observation. Surveys are generally conducted during daylight hours on relatively high volume roads. For all jurisdictions, both Marburger and Lawson believe that it is important to attempt to collect reliable usage information to evaluate the effectiveness of belt use programs. The observation survey techniques currently used only rarely incorporate well-designed statistical samples of traffic, which limits their utility for multi-national comparative assessments. However, survey sample sizes are generally large and the surveys within any given jurisdiction are generally internally consistent, which permits the examination of belt use trends over time within a nation.

The discussants, H. Knoflacher, Austria; S. Lassare, France; M. Dale, United Kingdom; and N. Hatfield, U.S.A.; addressed some of these topics at greater length.

Professor Knoflacher reviewed the OECD data and found little evidence that public information campaigns had much bearing on use rates. He also saw little evidence of cultural differences having an impact on belt use. In contrast to Switzerland, where cultural differences might account for observed belt use patterns in different sections of the country, other cases were cited where belt use was homogeneous while the population was culturally diverse (i.e., Austria) or where belt use varied widely across very similar populations (i.e., Northern Ireland and the Republic of Ireland).

Lassare and Dale both commented on methodological issues that made multi-national comparisons inappropriate. Lassare focused on the need to control for confounding variables and suggested that attitude surveys might be used as an important adjunct to roadside belt use observations.

Dale discussed how the availability of disaggregated traffic data made the development of reliable belt use estimates a possibility in the United Kingdom. However, in the absence of detailed VMT data he did not believe that statistically sound samples could be designed.

Hatfield, the final discussant presented some initial findings from belt use surveys in 12 Texas cities showing wide variations in observed belt use.

The workshop discussion then returned to the importance of removing observer bias from survey data to the fullest degree possible as well as carefully defining what was meant by usage (per VMT, per trip, etc.). There was strong consensus that consistent survey guidelines should be developed. It was agreed that reliable belt use results are needed for assessing the effectiveness of belt use laws.

SESSION 3 - Casualty Reductions Resulting from Safety Belt Use Laws

Session 3 began with a presentation by J. Hedlund on the impact of safety belt use laws on casualties and with a presentation by B. Sabey of the British government's assessment of their safety belt use law.

Sabey's presentation of the British experience showed a consistent pattern of casualty reductions stemming directly from the very large increase in safety belt use. She described two separate and independent studies that were conducted, one by the government's TRRL and one by the London School of Economics.

Hedlund, reviewing data from a variety of OECD jurisdictions, arrived at a similar conclusion. Hedlund found that motor vehicle occupant deaths and injuries fell with increases in belt use. The fatality reductions were more variable than the injury reductions but both series indicated that belt use laws are effective means of enhancing traffic safety. Hedlund's data indicate that large reductions in vehicle occupant deaths and injuries are possible and that there is no evidence that these reductions are offset by increases in other areas, due to belted drivers taking more risks.

In the following table, Hedlund shows belt use changes and casualty reduction performance resulting from a belt use law in twelve different jurisdictions. In this analysis, the term belt performance is a measure of the proportionate casualty reduction resulting from a belt use law, taking account of the casualty reductions produced by voluntary belt use before a law and also taking account, when possible, of casualty trends. Belt use law performance should be compared with a generally-accepted belt effectiveness estimate of 40 to 50%: that is, that a safety belt, when properly used, will reduce serious injuries or fatalities by 40 to 50 percent. A lower belt use law performance does not mean that safety belts are not 40 to 50 percent effective, but rather that they are not used as often by those who need them -- those involved in crashes -- as they are by those in the general driving population -- those for whom belt usage data are available.

Belt Usage Changes and Casualty Reduction Performance of Belt Use Laws

	Usage			Fatality		Injury[4/]	
Country	Pre-Law	Post-Law	Years[1/]	Count[2/]	Performance[3]	Count[2/]	Performance[3/]
Ireland	15%	45%	3	570	0%	4,900	0%
Victoria	15	48	4	2,670	40	71,000	42
Canada	24	50	11	34,000	37	1,700,000	20
New York	16	57	1	1,500	15	--	--
Denmark	19	67	2	640	13	15,000	27
Switzerland	37	76	2	1,000	35	30,000	35
Israel	10	80	4	220	41	930	27
Sweden	35	84	2	1,200	23	28,000	36
New Zealand	33	86	4	1,700	31	2,600[5/]	43[5/]
Norway	59	87	2	350	neg.	11,000	44
Germany	58	92	1	6,000	51	60,000	44
UK	40	94	4	7,770	32	106,000	38

[1/] Years: Total data collection period, pre- and post-law.
[2/] Count: Approximate number of occupant casualties during the data collection period.
[3/] Performance: Estimated belt law performance.
[4/] Injury: Defined differently in different countries.
[5/] Driver only, 2 years of data.

Based upon data from a number of OECD nations, it was clear that belt use laws become increasingly effective as belt use levels increase. Hedlund found this to be one of the few traffic safety countermeasures where marginal benefits increase rather than decline with increased application of the countermeasure. This means that it is very important to pursue the steps necessary to reach the highest possible levels of safety belt use.

Hedlund advanced the hypothesis of "selective recruitment," that as belt use rises, each new group of belt users is successively more likely to be involved in a potentially injury-producing crash accounting for the fact that belt use laws become relatively more effective as belt use increases. This hypothesis fits the available data and can be supported by limited research.

The issue of casualty reduction was then discussed by W. Rutherford, U.K.,; B. Aldman, Sweden; J. Versace, U.S.A.; and A. Wagenaar, U.S.A.

Rutherford presented the results of his study, The Medical Effects of Seat Belt Legislation in the United Kingdom. This study used data from 14 hospitals around the United Kingdom to test seventeen hypotheses regarding injury reductions that should have occurred if the safety belt use law was effective. Almost every one of these hypotheses was sustained. The study revealed a 15% reduction in patients brought to the hospital, a 25% reduction in hospital admissions, and a wide range of reductions in specific injury for both drivers and front seat passengers.

Aldman presented information derived from the Swedish experience that supported Hedlund's theory of "selective recruitment." Aldman was able to examine the belt use of three groups -- belt users prior to the law, non-belt users who became belt users with the enactment of the law, and continuing non-belt users. He showed that the accident involvement rate for the last group was far higher than for the first two groups. This resulted in casualty reductions not being as large as would have been predicted given the increases in belt use.

Versace commented on the importance of controlling for trends and believed that Hedlund's attempt to address that issue was an important contribution to the literature. Versace went on to raise a number of issues that will be of importance in the U.S. -- in particular, the issue of the relative effectiveness of the various passive restraint technologies being developed and how well they will interact with belt use laws. He believed that high quality evaluations will be increasingly more important.

Wagenaar agreed with Versace on several points -- particularly on the importance of explicitly controlling for trends in any analysis. This clearly increases the confidence that one can place in an analysis. Wagenaar then described the recent experience in the state of Michigan since the enactment of their belt use law.

In the workshop discussion, there was a great deal of emphasis placed on the need for high quality evaluations of casualty trends following enactment of belt use laws. There is surprisingly little data available considering the importance of this issue and the relatively large number of laws that have been in effect for at least ten years.

The workshop also addressed the subject of risk compensation and found little data that demonstrated the relevance of this theory to belt use effects. However, it was believed that the entire issue of risk perception and its impact on driver behavior was of sufficient interest that it should be addressed in more detail as a separate research topic.

SESSION 4: Rear Seat Belt Use and Child Restraints

Session 4 was organized in two parts, structured around a presentation by A. Nygren and C. Tingvall on rear seat belt use and effectiveness and around a presentation by M. Dejeammes on the effectiveness of child restraint use laws.

The Nygren/Tingvall presentation began with a risk assessment that concluded if injury data are controlled for occupant age, there is no meaningful difference between the risk of injury for front seat and rear seat occupants. As was found by Vaaje, these authors also found that few jurisdictions require rear seat belt use and fewer still enforce these provisions. The result is that even where rear seat belts are available and their use is required, the usage levels are far below those for front seat occupants.

Turning to the question of the effectiveness of rear seat belts, Tingvall and Nygren were able to cite limited data from Sweden, Canada and Australia indicating that the use of seat belts in the rear does reduce casualties.

Remarks by J. Christiansen, Denmark; H. Norin, Sweden; and L. Smith, U.S.A.; elaborated on some of these issues. Christiansen, while supporting the findings of Tingvall and Nygren in general, did not agree with their finding that the risk of injury to rear seat occupants is the same as that for front seat occupants. Norin presented data that confirmed Tingvall and Nygren's effectiveness findings. Smith discussed a clinical study underway in the U.S. that is finding some problems with the performance of lap belts in the rear seat.

This latter issue became the focus for much workshop discussion. It was concluded that while seat belts appear to be as effective in the rear as in the front seat, concern was expressed, based upon limited evidence, that poorly designed seat belts, particularly lap belts, and their misuse, may result in some seat belt induced injuries. However, there is no technical reason why rear seat belts cannot be designed to be as effective as front seat belts. On balance, a rear seat occupant is safer when the available restraint is used than when that individual is not restrained.

This led the workshop to agree upon two suggestions -- first, that properly designed lap/shoulder belts should be available in the rear seat and second, that governments should give serious consideration to requiring the use of available rear seat restraints.

The session then moved to the subject of child restraint laws. Dejeammes' presentation covered a wide range of subjects. The presentation examined the injuries to children in crashes. While children are less likely to suffer injuries than adults, the use of child restraints can reduce this risk further.

The presentation then examined the wide variety of child restraints available within the OECD. While not yet as extensive as safety belt use laws, child restraint laws are in force in a number of OECD jurisdictions. Although the laws and the available restraints differ widely, the data indicate that the use of available child restraints is an effective means of reducing casualties.

The evaluations of child restraint laws and programs do, however, identify a number of problems. The most pervasive is the misuse of child restraints. This frequent misuse argues that child restraints should be easier to use and that better education on proper child restraint use is needed. In addition, more work needs to be done to better understand the relative effectiveness of the wide variety of restraint systems available.

The discussants for this issue, B. Sabey, U.K.; C. Kahane, o.S.A.; and E. Weinstein, U.S.A.; focused on child restraint use and effectiveness in their respective countries.

Sabey reported on the British experience which indicated that children were found more frequently in the rear seat (where belt use is not required) after the enactment of their safety belt use law. Among younger children there was a decline in use of child restraints in the rear and an associated increase in casualties.

Kahane reported preliminary results from his study of child restraint effectiveness in the U.S. He confirmed the importance of proper use in order to reach high levels of injury reduction. With respect to misuse, Kahane's study found 39% correct use, 40% partial misuse (child fastened to the seat and the seat fastened to vehicle, but improperly in either or both cases) and 21% total misuse.

His assessment found child restraint use laws to be effective in reducing serious injury. His data revealed that: unrestrained children in the rear were 27% safer than unrestrained children in front seats; children using adult belts were 33% safer than unrestrained children; and children in child seats were 46% safer than unrestrained children (based on 71% effectiveness when restraints were properly used, 44% when partial misuse occurred and 0% when they were totally misused).

Weinstein raised a number of important U.S. child restraint issues. One was the compatibility of child restraints and certain configurations of safety belts. A second was the use of inertial reel retractors with child restraints. Further, the advent of automatic safety belts will further complicate the proper use of child restraints.

Safety Belt Use Research Agenda

The workshop concluded with an exploration of future research needs.

This assessment of safety belt use laws made the need for consistent data very clear. The inability to explain differences in belt use rates achieved under relatively similar laws argues that efforts to improve safety evaluation methodology are still sorely needed.

The workshop participants concluded that the most important research requirement is for nations carefully and consistently to evaluate the casualty reductions resulting from belt use laws. Most nations have available sufficient data with respect to motor vehicle crash injuries and belt use to permit more assessments of safety belt use laws to be produced. Evaluations of belt use laws should use a number of methods to control for trends and the evaluations should be conducted periodically.

The quality of any analysis is dependent upon the quality of the available data. Therefore, it is important to collect higher quality data with respect to motor vehicle injuries. Consideration should be given to using disability scaling as an additional measure of injury severity. Better injury data will be needed as nations monitor changes in injury patterns that result from safety belt usage. Analyses of these data will contribute to the development of improvements in restraint system and vehicle design. This is particularly true with respect to the design of safety belts in the rear seat, where major improvements in belt design are desirable.

With respect to determination of belt use levels, survey guidelines should be developed that minimize observer introduced bias and maximize consistency between data collected in various jurisdictions. This is a greater problem for nations that have not achieved the very high rates of belt use that are possible. For these nations, more care is required in collecting belt use data as it is important to develop public education programs that are targeted at those segments of the population that do not use their belts.

The area where the least amount of data is available is public education. Here, the OECD workshop participants were unable to evaluate the effectiveness of public information programs in conjunction with safety belt use laws. While the group concluded that public information programs were essential, there was no agreement as to how to quantify these programs in order to evaluate them. As an important first step, the group believed that it is necessary to develop a means of quantifying public information programs if one is to evaluate their effect on belt use.

Workshop Findings

The workshop's examination of safety belt use laws did produce a consensus on a number of issues.

First, with regard to the laws themselves, it was agreed that the essential ingredients of a successful safety belt use program are (a) the availability of well designed safety belts, (b) a clear, simple safety belt use law and (c) a commitment to enforce the law. It is clear that this commitment requires public education as well as enforcement. Further, it was agreed that complex and widespread exemptions under the law can undermine the effectiveness of a belt use program.

Second, since the benefits of safety belt use laws increase with increasing levels of belt use, it was agreed by the workshop participants that governments should strive to raise safety belt usage to the highest possible levels. Three jurisdictions (United Kingdom, Germany and parts of Australia) have succeeded in sustaining safety belt use above 90% and have achieved substantial benefits.

Third, with regard to safety belt use by rear seat occupants, the limited data available indicate that they are an effective means of reducing injuries. Further, unrestrained rear seat occupants pose a hazard to front seat occupants and increase the front seat occupants' risk of crash injuries.

Finally, children should be restrained when in vehicles, preferably by well designed child restraints.

SAFETY BELT USAGE LAWS IN VARIOUS COUNTRIES

Tore Vaaje

This report summarizes the review of sections of the completed OECD questionnaire regarding safety belt usage laws. A narrative summary of the responses to each question is provided below.

Countries Responding

Thirty-three responses from 15 countries, 8 Canadian Provinces, 8 Australian states and one USA state, were received and summarized. The answers are referring to the beginning of 1985.

Effective Date of Usage Law

The effective date of usage laws in the various jurisdictions are presented in Figure 1. Of those countries responding, Australia and New Zealand were the first to adopt such a law in 1970 and 1972 followed by France in 1973. Thirteen of the responding jurisdictions adopted safety belt usage laws between 1975 and 1977. More recently, six jurisdictions adopted laws between 1983 and 1985. Italy has no legal requirement for the use of seat belts, the only one of the responding countries.

During 1985 sixteen of fifty U.S. States have introduced seat belt laws. However, except for the State of New York, they are not covered by this study.

Roads Covered by the Law

Safety belt usage laws are applicable to all roads for all but one of the countries responding to the questionnaire. In Spain the law is applicable only to roads outside build up areas.

Vehicles' Covered

The categories of vehicles covered by the corresponding number of responding jurisdictions are shown below:

Vehicle Categories	Number of Jurisdictions
Cars only	6
Cars/Wagons/Vans	17
All Vehicles with Belts installed	10

Normally the safety belt fitting regulation and the usage law for front seat is corresponding. After a period with mandatory installations only, the laws are extended to mandatory use. The same pattern we now can observe for the rear seats.

Most Common Exemptions to the Law in the Various Jurisdictions

The jurisdictions of Germany, Norway, Austria (1984 or newer vehicles), the Australian states and four of the eight Canadian provinces require belt use in both the front and rear seats. All the other jurisdictions require belt use in the front seat only.

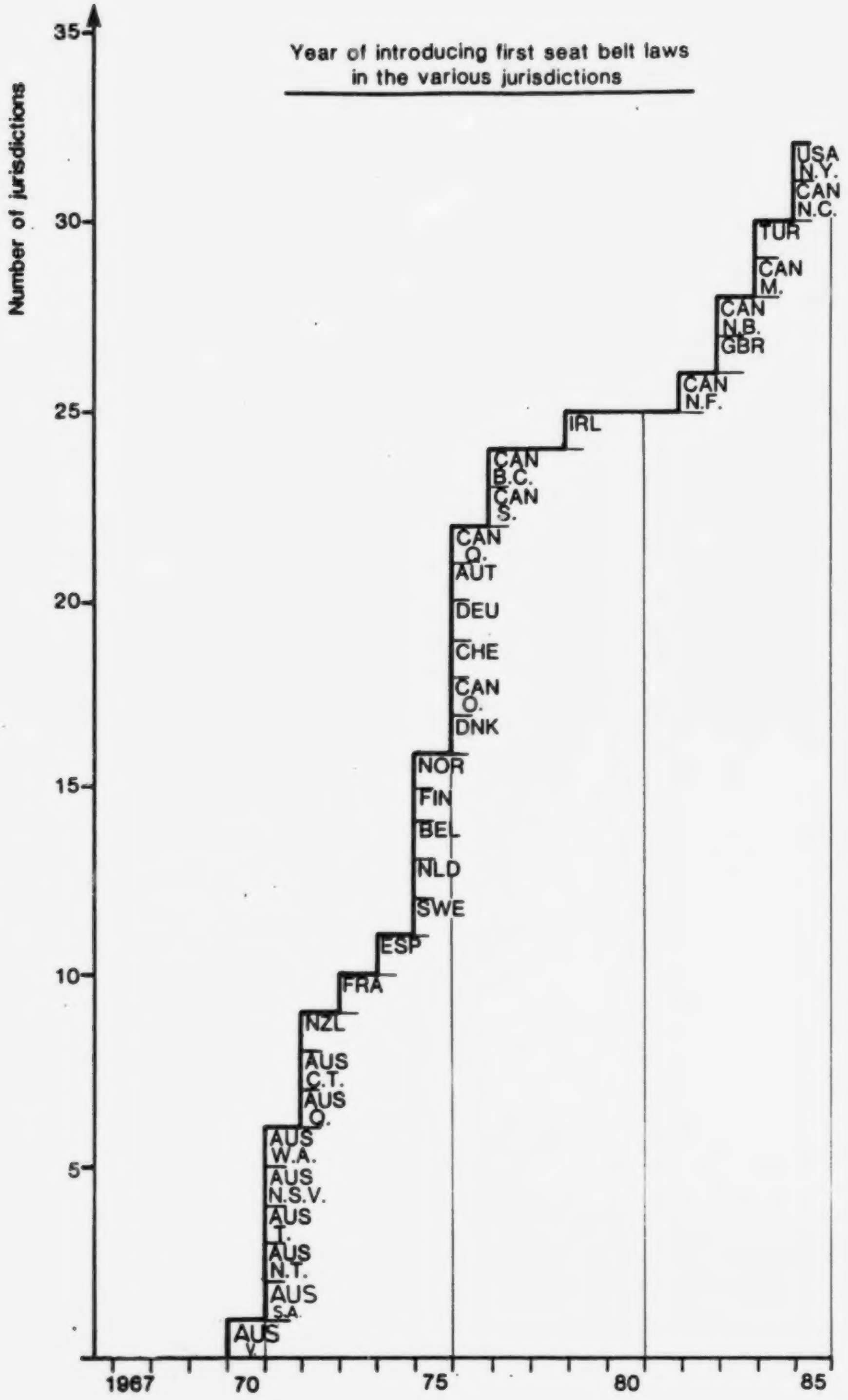

Figure 1. The effective year of introducing seat belt laws in the various jurisdictions. The ISO country code is used to identify countries.

Of these 15 jurisdictions, 11 require seat belt use in the rear seat when belts are available. Three of them only for cars which have mandatory installed seat belts in the rear seats, and one if the belts are factory installed.

Most countries allow exemption for medical reasons, for delivery drivers and short people, including children. Several countries exempt taxi and emergency vehicle drivers. The table below shows which group of occupants are exempted in the various jurisdictions and positively indicated in the responses to the questionnaire.

Group of Occupants Exempted	Number of jurisdictions which positively indicated this exemption
Below given age	17 (Alternative age limits are 1, 5, 8, 12 and 15 years)
Taxi drivers	10
Delivery drivers	16
Reverse maneuver	15
Pregnancy	1
Medical reasons	18
Above given size	5
Over given age	1
No information	5

Penalties for Noncompliance

All responding jurisdictions have a maximum fine and many have a minimum fine. Maximum fines range from USD 4 in Turkey to USD I350 in the Netherlands, but the typical normal fine imposed in the various jurisdictions is between 4 and 75 USD.

o 6 jurisdictions have a normal fine below USD 10

o 14 jurisdictions have a normal fine between USD 10 and 20

o 5 jurisdictions have a normal fine between USD 20 and 30

o 6 jurisdictions have a normal fine above USD 30

o 2 jurisdiction have no law or information is missing

Only the Netherlands and the Australian states of Victoria and North Territory allows for a possible jail sentence for nonuse of belts, but only if fines are not paid. Nineteen of the jurisdictions allow reduced compensation for unbelted accident victims. Eleven of them specify a range of reduced compensation from 15 to 50 percent.

Enforcement of the Law

For all responding jurisdictions, enforcement of the law is the responsibility of any police force responsible for traffic enforcement. The relative proportion of enforcement actions of different police authorities (where more than one exists in a particular jurisdiction) is dependent on the manpower allocated to each authority for traffic enforcement. All of the jurisdictions enforce the law when a motorist is stopped for another offense. In addition, almost all (26 out of 32) enforce the law directly. Those countries not directly enforcing the law include Turkey, Sweden, the Canadian Province of Saskatchewan. Warning tickets are given to nonusers in most of the jurisdictions except for Australia, Finland, Norway, Sweden, Germany, New Zealand, the Canadian Provinces of Quebec, Saskatchewan, British Columbia, New Brunswick and the State of New York, U.S.

Only 19 jurisdictions provided sufficient information to determine the level of belt use enforcement. This was done by calculating the percent of tickets issued for nonuse of belts as compared to the overall number of tickets issued for all traffic offenses. This percent ranged from a low of about 1 percent to a high of about 18 percent.

The distribution of the level of enforcement in the various jurisdictions is:

- Below 5% of all tickets: 6 jurisdictions
- Between 5 and 10% of all tickets: 9 jurisdictions
- Above 10% of all tickets: 4 jurisdictions
- For 14 jurisdictions no information was available

Major Efforts to Improve Levels of Belt Usage

All jurisdictions responding have undertaken a variety of public information programs to increase safety belt usage rates. An insurance company in Sweden provides an insurance discount to car owners who "guarantee" that all occupants will use their safety belts in the rear seats. The eleven jurisdictions that have undertaken special enforcement campaigns to encourage belt usage are: New Zealand and the Canadian Provinces of British Columbia, Ontario, Quebec and Newfoundland, and six Australian states.

Effect of the Law on Safety Belt Usage Rates

Usage laws have substantially increased the level of safety belt use. The range of usage before laws were adopted ranged from 4 percent to 40 percent. Based on the most current information available, usage after the law was adopted ranged from 46 percent to 97 percent.

Further Efforts to Increase the Safety Belt Usage Rates

The Role of the Insurance Companies:

The insurance companies can in principle influence the wearing rates of seat belts through their regulations in three different ways:

- By reduced crash victim compensation when safety belt are not used
- By increased crash victim compensation when safety belts are used
- By reduced premiums for owners/drivers who can guarantee that all occupants always use their safety belts

The first principle is normally applicable when there exists a safety belt law compelling the occupants to use safety belts. The second principle is applicable to situations where there exists either a belt law or belt use is voluntary. The third principle is applicable only where safety belt use is voluntary.

The majority of jurisdictions covered in this survey allows reduced victim compensation when seat belt is not used at accidents. However, there exists no information as to what extent this regulation is used in the various responding countries.

The two latter regulations, increased crash victim compensation and reduced premium, were not covered by questions in the OECD questionnaire. These regulations are, however, used by some insurance companies.

A Swedish insurance company offers reduced premium for those car owners who guarantee that all passengers in the rear seats always use restraints. Restraints used in rear seats are not provided by law in Sweden so far.

Enforcement and Public Campaigns:

A safety belt law alone is not sufficient to bring the wearing-rates of safety belt to a satisfactory high level. It is also important to:

Introduce sanctions for not following the law

Enforce the law

Inform the general public about the benefit of using safety belts, about the safety belt law and the consequences of not complying with the law

In some countries there was initially no sanctions for not using safety belts. This was the case in Germany and in Norway. However, the importance of sanctions is demonstrated by the fact that the wearing rates in countries without sanctions did not exceed more than 30 percent inside and about 60 percent outside build up areas after the belt law was introduced. These wearing rates were far below those experienced in countries with a fine for not using seat belts. When Germany and Norway introduced sanctions for not complying with the law, the wearing rates increased to the same level as in the countries which already used sanctions.

The importance of enforcement is not known to the same extent. In the Nordic countries the wearing rates are now slightly decreasing. The lack of sufficient enforcement is claimed to be the reasons for this.

Information campaigns have always been a major activity to convince car occupants that use of seat belts is a very important measure for avoiding injuries in a car crash. However, in spite of the realization of most people that use of safety belts is effective in protecting themselves, the wearing rates remain low in the pre-law stage. Only a safety belt law in combination with sanctions, a satisfactory high wearing rate were experienced. In the period after the seat belt laws were effective, most countries performed public campaigns regularly. However, it seems that this activity was not so heavily emphasized as before the laws were passed. With few exemptions, these campaigns are not evaluated.

One experience from Victoria, Australia is worthy of mentioning 1). The experience from the "Buckle up in the Back" campaigns from October 1981 to February 1982 is interesting. In 1980 the overall usages rate in rear seats was only 19 percent compared with 85 percent usage rates in the front seats. This low rate was experienced in spite of a legal requirement to use belts in the rear seats. The legislation introduced in 1970 covered both front and back seat passengers. The study shows that it was a general lack of awareness of the law, which was reinforced by lack of enforcement of seat belt use in the rear seats which contributed to the low rate.

The campaigns which were aimed at increasing the use of rear safety belts used a variety of news and advertising media and other activities, such as: television, radio, articles published in the press, advertising into the print medium, displays, and police enforcement. On December 20, 1981, legislation was introduced requiring the use of restraints (where available) for children under eight years old occupying the rear seat. The overall rear seat restraint usage increased for 39.5 percent (October 1981) to 67.0 percent (March 1982). A more recent study (November 1982) shows an overall rear seat belt usage of 80.0 percent. A corresponding reduction in rear seat casualties was also observed.

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1) Lane, J.; Milne, P.; Wood, J.: Evaluation of the 1981/82 Rear Seat Belt Campaign. Road Safety and Traffic Authority. Hawthorn, Victoria 1983.

However, in most countries there is a general lack of evaluation of campaign activities to increase safety belt usage.

Extension of the Coverage of the Safety Belt Usage Law

All jurisdictions with a safety belt usage law have a number of limitations to the compulsory use of restraints. Besides Australian and Canadian provinces only Germany and Norway have a legal requirement to use safety belt in the rear seats. Recent studies show that the injury risk in the rear seats are similar to that in the front seats. Children under the age of 15 years or people shorter than 150 cm are in most jurisdictions not covered by the laws. The reason for these exemptions is hard to justify since recent studies have demonstrated that children have at least the same benefit of safety belts as adults have.

A number of other groups of vehicle occupants are exempted from the compulsory use of safety belts in most of the jurisdictions covered. Occupants of heavy vehicles; bus passengers; taxi drivers and passengers; and pregnant women are some examples of groups which obviously will benefit from an extension of the seat belt law coverage.

A further development in protecting vehicle occupants should be based on a program to include more vehicle seat positions covered by the compulsory fitting and reducing the number of groups exempted from the safety belt usage law.

Table 1A. Seat Belt Laws in OECD-countries

Country	Date belt use mandatory	Mandatory in back seats? (from date)	Vehicles covered	Occupants exemted 1)	Normal fine (max fine)	Other penalties applied 2)	How is the law enforced? 3)	Enforced by national or local police?	Extention of enforcement	Seat belt use before the law	Seat belt use after the law	Seat belt use currently	Major efforts to increase seat belt use A. Enforcement B. Campaigns C. Other	Comments
Australia New South Wales	10/71	Yes, when seat belt available	Cars/ wagons	1,6. Some vehicles	AUD 50 (USD 34) Max AUD 500	2	1,2,3	State police	28.000 tickets/year (4% of all tickets)	12-26%	62-80%	86-88%	B. Mass Media Campaign during 1983. Click/clack front and back. N.R.M.A. Support during campaign.	
Australia Victoria	12/70	Yes, from 12/70 when seat belt available	Cars/ wagons/ trucks	6. Some delivery vans	AUD 40 (USD 27) Max AUD 200	1,3 (1 only if fine not paid)	1,2,3	State police	29.000 tickets/year (6% of all tickets)	Front seats: 25%	Front seats: 75%	Front seats: 95% Rear seats: 55%	A. Special enforcement campaigns are run to co-inside with publicity campaigns. B. The last publicity campaign was in 1981, the next in 1985. The campaign was successful in encouraging rear seat passengers to use restraints (Lane, Milne & Wood, 1983).	From 12/70 the law applicate to vehicle-occupants aged 8 years and over who have seat belt available. From 1974 retro-fitting legislation. From 1/76 children under 8 years of age were required to be suitably restrained in front seat, from 12(71 in both front and rear seat
Australia Queensland	1/72	Yes, when seat belt available	Cars/ wagons	1,6. Some vehicles	AUD 20 (USD 13)	2	1,2,3	State police	27.000 tickets/year (9% of all tickets)			74%	A. Periodic Blitzes by Police B. Media campaigns, press and radio C. Bumper stickers, displays etc. School lectures, defensive driving course	Compulsory child restraint usage and excemption for taxi drivers carrying passengers are changes after the initial law.
Australia Western Australia	12/71	Yes, when seat belt available	Cars. Goods vehicles, from 5/81	1(1-69 years only) 3,4,6 Some vehicles	AUD 40 (USD 27)	2	1,2,3	State police	2900 warnings/year 14.000 tickets/year (7% of all tickets)	25%	50%	90%	A. Blitzes prior to and during long weekend holiday period B. Newspaper campaigns over many years promoting all aspects of road safety, including restraint usage C. Media releases throughout the year	Fine: AUD 20 until 76, AUD 10 1976-80, AUD 20 1982, AUD 40 1982. Minimum age reduced from 5 years to 1 year 1981
Australia South Australia	11/71	Yes, from 11/71	Cars/ wagons	1(under 8 years) 2,3,4	AUD 25 (USD 17) Max AUD 300	3	1,2,3	State police	8700 tickets/year (6% of all tickets)	23%	78%	88%	A. One of the factors emphasized during statewide "Holiday Weekend" Road Safety Campaigns. B. Periodic mass media campaigns, often in conjunction with police enforcement activity. Most recent directed toward rear seat belt and child restraint usage. Usage for rear seat passengers increased from 40% to 61%, children 48% to 63%, front seat passengers 79% to 85% (Drivers 91%). C. Bassinetts/Child Restraint loan/rental scheme pending.	From 5/84 all persons over 70 years required to wear seat belt
Australia Tasmania	10/71	Yes, when seat belt available	Cars/ wagons	3,4,6	AUD 20 (USD 13) Max AUD 200	2	1(90%) 2(6%) 3(4%)	State police	845 warnings/year 40.000 tickets/year (11% of all tickets)	N.I.	N.I.	N.I.	A. Seat belt blitzes on regular basis about 12 times per year B. Publicity on radio has resulted in approx. 15% decrease of offenders	Sept 1984 amendment: o Adults must sit in a seating position where seat belt is fitted if available o Children between 1 and 8 must wear child restraint or seat belt if available o Max penalty increased from AUD 20 to AUD 200
Australia Northern Territory	1/71	Yes, when seat belt available	Cars/ wagons	1(1 year) 3,4,6 Some vehicles	AUD 20 (USD 13) Max AUD 200	1,2	1,2,3	Local police	500 warnings/year 2000 tickets/year (18% of all tickets)			1984 Driv: 87% Pass: 70% Child: 68%	A. Police enforcement campaigns during Holiday periods i.e. Easter and Christmas. B. Road Safety Council - Television and Radio, Student driver Education, and displays. C. Lectures at schools and to the public by police and Road Safety officers.	Police and Road Safety Council cooperate in public awareness and enforcement programs. This cooperation has been largely responsible for increased usage rates.
Australia Australian Capital Territory	1/72	Yes, when seat belt available	Cars/ wagons	1(1 year and over 70), 3,4 Some vehicles	AUD 20 (USD 13)	2	1,2,3	Aus. Fed. Pol. force	4318 warnings/year 600 tickets/year (3% of all tickets)	N.I.	N.I.	81%	B. TV advertising campaign	

1) Occupants exemted
1. Under x years of age
2. Taxi drivers
3. House to house delivery
4. Driving during reverse maneuver, standing still
5. Pregnancy
6. Medical reasons
7. Postal delivery
8. Below given size

2) Other penalties applied
0 = None
1 = Imprisonment
2 = Reduced crash victim compensation
3 = Reduced crash victim compensation in special cases only

3) How is the law enforced?
1. When stopped for another purpose
2. Strictly - when observed not wearing belt
3. Warned - only requested to buckle up by officer

N.I. = No information

Table 1B. Seat Belt Laws in OECD-countries

Country	Date belt use mandatory	Mandatory in back seats? (from date)	Vehicles covered	Occupants exemted 1)	Normal fine (max fine)	Other penalties applied 2)	How is the law enforced? 3)	Enforced by national or local police?	Extention of enforcement	Seat belt use before the law	Seat belt use after the law	Seat belt use currently	Major efforts to increase seat belt use A. Enforcement B. Campaigns C. Other	Comments
Austria	7/76 Without fine 7/84 With fine	Yes, only for cars with vehicle-approval after 1/84	Cars and vans less than 3500 kg	N.I.	ATS 100 (USD 4) Max ATS 300	2	1,2,3	National 60% Local 40%	N.I	30%	Before fine 40% After fine 80%	65% 11/84	B. TV-spots, competitions, posters, exhibitions, press campaigns, ad. campaigns C. Information through scientific documentations	
Belgium	6/75	No	Cars and vans	5,6,8	BFL 500 (USD 8) Max BFL 10.000	3	1,2,3	Both. Proportions not stated	N.I.	15%	80% immidiate after the law	70% on rural areas, 60% in urban areas 11/84	A. The police gives warning only, thereafter penalties B. Information campaigns in general accompany police actions. Major information to the public in 1971, 1973, 1974, 1975, 1978 and 1982	
Canada New-Foundland	7/82		All in which seat belt is required	1(5 years) 4,6,7 3(below 50 km/h) Driving school instructors. Driver examinators.	CAD 35 (USD 19) Max CAD 500	1,3	1,2,3	National 60% Local 40%	Local police 2500 tickets/year. 4% of all ticket fines	24,4%	78,7% one year after the law	73,9% 7/84	A. Blitzes B. Radio, newspapers, TV, display of crash vehicles, speaking tours with movies C. Special presentation to police forces	
Canada Nova Scotia	1/85	1/85 If seat belt is available	All	2,3,4,6 Peace officer, bus drivers	N.I.	N.I.	N.I.	N.I.	N.I.					
Canada New Brunswick	9/83	Yes, if factory installated belts	All equipped by manufacturers	6	CAD 25-100 (USD 19-75)	3	1,2	Local police only	Est 10% of enforcement				B. Extencive media campaigns C. Brochures	Out of province children exemted
Canada Quebec	8/76	No	Cars used for transport of 10 people or less	6	CAD 25-50 (USD 19-37)	0	1,2	Provincial police 1/3, city police 2/3	18.000 ticket/year. 1% of total tickets				A. Special limited and regional blitzes B. One major campaign	From 4/1982 it is mandatory for children under 5 years or younger to be retrained in front seats. Committee has proposed that all car passengers should use a seat belt
Canada Ontario	1/76	Yes, from 11/83 when belts installed	All vehicle with factory installed seat belts	2,3 (max 40 km/h) 4,6,8	CAD 53 (USD 40) Max CAD 200	2 (15-20%)	1,2,3	Provincial 38% municipal 62%	104.000 ticket/year. 8% of all tickets	17,2	76,9% immidiate after the law. 1977 48,7% use for drivers		A. Periodic blitzes B. Campaign using newspaper, radio, TV, pamphlets, poster and films, displays at major events	
Canada Manitoba	1/84 enforced 4/84	?	All motorvehicles with the exception of motorcycles	?	CAD 30 (USD 22) Max CAD 100	0	1,2,3	N.I.	N.I.	Drivers use: 4/83 10,7%	Drivers use: 2/84 33,5%. 6/84 79,1%		B. Extensive radio, TV and pamphlet campaign C. Alive campaign	

1) Occupants exemted
1. Under x years of age
2. Taxi drivers
3. House to house delivery
4. Driving during reverse maneuver, standing still
5. Pregnancy
6. Medical reasons
7. Postal delivery
8. Below given size

2) Other penalties applied
0 None
1 Imprisonment
2 Reduced crash victim compensation
3 Reduced crash victim compensation in special cases only

3) How is the law enforced?
1. When stopped for another purpose
2. Strictly - when observed not wearing belt
3. Warned - only requested to buckle up by officer

N.I. = No information

Table 1C. Seat Belt Laws in OECD-countries

Country	Date belt use mandatory	Mandatory in back seats? (from date)	Vehicles covered	Occupants exemted 1)	Normal fine (max fine)	Other penalties applied 2)	How is the law enforced? 3)	Enforced by national or local police?	Extention of enforcement	Seat belt use before the law	Seat belt use after the law	Seat belt use currently	Major efforts to increase seat belt use A. Enforcement B. Campaigns C. Other	Comments
Canada Saskatchewan	7/77	No	All passenger vehicles	1(5 years)	CAD 20 (USD 15)	2 (up to 25%)	1	50/50	10.000 tickets/year. 8% of all tickets	25%	60% one year later	60% 11/84	B. Seat belt brochures, ads. C. Seat belt survivor's campaigns	Max usage 73% 1/2 year after the law
Canada British Colombia	10/77			2 (speed less than 70 km/h) 3,4,6 police	CAD 35-50 (USD 26-37) Max CAD 100	2 (25-30%)	1,2	All police force	N.I.	25%	After one year: 80%	65% 11/84	A. 2-3 blitzes, media campaign per year B. TV. ad., radio ad., newspaper ad.	
Denmark	1/76	No	Cars, vans	1(15 years) 2,3,4,6	DKK 100 (USD 9)	0	1,2,3	Both	3500 tickets/year. 4% of all tickets	19%	One year after: 74%	70% 11/84	B. TV-information and pamphlets	
Germany (Federal Republic of)	1/76 without fine 8/84 with fine	Yes 8/84 Only for new cars after 5/79, without fine	Cars and vans less than 2800 kg	1(12 years 2 in job 3 4 in special cases 6, persons smaller than 150 cm	40 DEM (USD 14) (only in front sesats)	0	1	In Germany there is only local police	N.I.	Before 11/75 30% urban 46% rural 70% motorw Before 3/84 47% urban 62% rural 81% motorw	/after law 3/70 42% 60% 79% /after fine 3/85 91% 93% 97%		B. Ongoing campaigns	
Finland	7/75	No	Cars	1(15 years) 2,3,4,6	FIM 100 (USD 15)	0	2	Both	Tickets 4800/1983 given by mobile police Est. activity for local police 2X mobile police				B. Posters, articles and ads. in newspapers, movies, TV-spots and ads.	To 3/82 warning only. From 3/82 fine, from 9/83 on the spot fine. Ministry is preparing a law for compulsory use of rear seat belts
France	7/73	No	Cars	1,6,8 police emergency	FRF 150 (USD 15)	3	1,2,3	National police	27.636 tickets/1983. 5% of all tickets				B. TV-spots	
Ireland	2/79	No	Cars and light vans		IFP 10 (USD 10) Max IFP 20	0	1,2,3	National police	N.I.	20%	One year after 45%	50% 11/84	B. Ongoing campaigns	
Italy	No law 1/85													
Netherlands	6/75		Cars	1 (12 years) 2, 3,4,6,8 cars older than 1971, special cars	NLG 35 (USD 9) for driver and front seat pass. NLG 50 (USD 14) for driver if both is not wearing seat belts	1,3	1,2,3	Both	N.I.	Inside: 10% Outside: 21%	Immediate after law Inside: 48% Outside: 61%	Inside: 46%, outside: 65% (1983)	B. National and regional campaigns via TV-radio, press and posters	Mandatory rear seat usage will be effective during next few years

1) Occupants exemted
1. Under x years of age
2. Taxi drivers
3. House to house delivery
4. Driving during reverse manoeuver, standing still
5. Pregnancy
6. Medical reasons
7. Postal delivery
8. Below given size

2) Other penalties applied
0 = None
1 = Imprisonment
2 = Reduced crash victim compensation
3 = Reduced crash victim compensation in special cases only

3) How is the law enforced?
1. When stopped for another purpose
2. Strictly - when observed not wearing belt
3. Warned - only requested to buckle up by officer

N.I. = No information

Table 1D. Seat Belt Laws in OECD-countries

Country	Date belt use mandatory	Mandatory in back seats? (from date)	Vehicles covered	Occupants exemted 1)	Normal fine (max fine)	Other penalties applied 2)	How is the law enforced? 3)	Enforced by national or local police?	Extention of enforcement	Seat belt use before the law	Seat belt use after the law	Seat belt use currently	Major efforts to increase seat belt use A. Enforcement B. Campaigns C. Other	Comments
New-Zealand	6/72	No	All motor vehicle with tare weight less than 2500 kg	1(8 years in front seats). 6 certain vehicles	NZD 25 (USD 11) Max NZD 200	0	1,2	Entirely separate enforcement authority for the traffic laws	4287 tickets/1983. 1-2% of all tickets excl. parking tickets	32%	1972: 87%	84-93% 1983	A. Regular annually inforcement campaigns B. Annual campaigns, one for adults, one for children C. Child restraint rental schemes from 1984	Changes: 1972: 15 years limit, 1978: 8 years limit, 1984: all ages. Exemtions under review
Norway	9/75 Fine from 9/79	Yes, from 3/85 for vehicles registered after 1/84	Cars and vans	1(15 years) 2,3,4 6,8	NOK 200 (USD 21)	0	1,2	Both	4700 tickets/1983, 6% of all tickets	Inside: 17%, outside: 39% Before fine Inside: 27%, Outside: 63%	One year after fine 11/80: Inside: 74% Outside: 90%	Inside: 66,2%, outside: 87,2% (11/84)	B. General enforcement through mass media, pamphlets, etc.	
Spain	4/74 Only on roads outside urban	No	Vehicles less than 2000 kg	Rear seat passengers	ESP 2.000 (USD 12)	0	1,2	Both	180.000 tickets per year=5,6% of all tickets	N.I.	51% (1979)	75% (1983)	A. Special Enforcement B. Special Public information campaigns every year since 1980 in mass media and also booklets and poster	In mind also urban areas and, further occupants of rear seats
Sweden	1/75	No	Cars	1(15 years) 6,8	SEK 100-2[illegible] (USD 11-22)	0	1	Only one police force	20.000 tickets, 7% of all tickets				B. Pre-law there was many campaigns. Post-law have focused on rear seat passengers and children C. A insurance company has reduced premium for those who garantee all (incl. rear seat and children) restrained	Taxi passenger in front included 83. Compulsory rear seat and childrens restraint use now discussed
Switzerland	1/76 to 10/77 and from 7/81	No	Cars, vans	1(12 years) 2,3,4,6 Emergency	CHF 20 (USD 7)	0	1,2	Police cartonale	N.I.	5/81: 40%	5/82: 72%	68% 5/84	B. Mass media. Posters	
Turkey	10/84	No	Cars, vans	?	TL 1500 (USD 4)	0	1,3	Local, national and gendarmes	N.I.	N.I.	N.I.			Old law 4/72: Wearing not compulsory, but recommended
United Kingdom	2/83	No	Cars, vans	2,3,6	GBP 50 (USD 55)	3	1,2,3	All police forces are local	N.I.	40%	One year after: 95%	95%	B. Extensive publicity using all media prior to the law. Effectiveness unknown	The current law is experimental. If not renewed, it will cease 1/86
USA New York state	1/85	Yes 1/85	All pass. motor vehicle equipped with belts	Back seat pass aged 10 or more	Up to USD 50	0	1,2	N.Y. police only	New law	N.I.	New law		B. Campaign is planned to include radio and TV-spot, newspaper, magazines, posters etc.	

1) Occupants exemted
1. Under x years of age
2. Taxi drivers
3. House to house delivery
4. Driving during reverse maneuver, standing still
5. Pregnancy
6. Medical reasons
7. Postal delivery
8. Below given size

2) Other penalties applied
0 = None
1 = Inprisonment
2 = Reduced crash victim compensation
3 = Reduced crash victim compensation in special cases only

3) How is the law enforced?
1. When stopped for another purpose
2. Strictly - when observed not wearing belt
3. Warned - only requested to buckle up by officer

N.I. = No information

SAFETY BELT USE RATES

E. A. Marburger

Problem areas meriting discussion

1. Survey methods
2. Which importance is attached to the assumed decreasing effects and can they be minimized?
3. Are there any external indicators to forecast changes in rates of belt usage owing to legislation (population, education, economic data)?
4. How can rates of usage correlating with true risk levels be attained?
5. Misuse and condition of seat belts.

Use rates

Belt Use Rates Before and After Mandatory Seat Belt Use Legislation

In 13 out of the 14 countries considered in this paper, mandatory seat belt usage legislation for front seat occupants has been or will shortly be introduced (Japan: as of September 1985). In all countries (with the exception of Turkey where mandatory usage came into effect in October 1984 and data on usage levels are not yet available), the introduction of mandatory usage has led to considerable increases in belt use rates (cf. Table 1). The rates--based on average rates--increased by between 40 and 65 %-points. Increases measured inside built-up areas amount to between 23 and 73 %-points and outside built-up areas (not counting motorways) between 25 and 62 %-points. The lowest increases have been measured on motorways, by approximately between 25 and 35 %-points, which is explained by the relatively high levels already measured on motorways before mandatory usage was introduced.

Differences In Use Rates and Accident Risks on Various Types of Roads

As long as high overall usage levels are not yet established, the rates of belt usage differ clearly between motorways, roads outside and inside built-up areas in most countries. It is assumed that these differences occur because drivers do not assess the risks involved correctly: "nothing will happen to me, I'm just going around the corner".

A risk measure calculated on the basis of road usage in terms of passenger kilometers or similar parameters is generally accepted as objective risk measure. The calculation of vehicle-kilometers is however a problem by itself, especially the distribution over the various categories of road. A survey of such data for the countries under consideration is not available. The distribution of car occupants involved in accidents over the various types of road requires a detailed analysis of national accident statistics. As an example, such an assessment is shown below for the Federal Republic of Germany:

In 1984:

- -- 5,129 persons were killed,
- -- 60,996 persons severely injured, and
- -- 189,945 persons suffered minor injuries in road accidents in Germany.

A breakdown of these figures into the types of road of interest is shown in the following table:

	Inside built up areas	Outside built up areas	Motorways	Σ
Killed	859	3 726	544	5 129
Severely Injured	21 267	34 953	4 776	60 996
Minor Injured	106 655	67 728	15 562	189 945
Σ	128 781	106 407	20 882	256 070

TAB. 1: SEAT BELT USAGE RATES OF CAR DRIVERS IN %

COUNTRY	BEFORE MANDATORY SEAT BELT USAGE LEGISLATION			AFTER MANDATORY SEAT BELT USAGE LEGISLATION			BEFORE/AFTER DIFFERENCE IN %-POINTS	MOST RECENT VALUE	PEAK
Austria		Before legislation	Before fine	9/84				8/85	
	Inside built up areas	5 - 10	10 - 15	81			ca. 70	81	-
	Outside built up areas	20 - 25	40	82			ca. 60	82	-
	Motorways			86				88	-
Belgium	15			Directly after legislation 80			65	12/84	Not known
								Inside built up areas 60	
								Motorway 70	
Denmark	19			74			55	70	75
Finland				warning only to 3/82	Fines or inprisonment 4/82	On-the-spot fine 9/83			
	Inside built up areas	9		30	87	82	73	See value 9/83	-
	Outside built up areas	30		68	86	92	62	"	-
France	Inside built up areas	at night	13	36			23	short trips: 60	Not known
		day		60					
	Outside built up areas	20		63			43	75	
	Motorways			83				95	
Germany		Before legislation	Before fine	9/84				3/86	See value 3/86
	Inside built up areas	30	47	88			58	92	
	Outside built up areas	46 } Ø = 42	62 } Ø = 58	94 } Ø = 92			48 } Ø = 50	95 } Ø = 94	
	Motorways	70	81	97			27	97	
Italy	No legislation							Less than 5	-
Japan	Legislation as of 9/85							1983	-
								Expressways: 29	
								Normal roads:23	
The Netherlands	Inside built up areas	10		48			38	45 (average) 40 (in towns)	60
	Outside built up areas	21		61			40	65 (average) 70 (on motorways)	75
Norway		Before legislation	Before fine						
	Inside built up areas	17	27	74			57	66	77
	Outside built up areas	39	63	90			51	87	90
Sweden	Inside built up areas	20		80			60	Average 85	-
	Outside built up areas	60		85			25		
	Motorways	60		85			25		
Spain	Not known			First counting in 5/79 51			Not known	75	-
Switzerland		Before 1. legislation	Before 2. legislation	After 1. legislation	After 2. legislation			5/85	5/76
	Inside built up areas	19	25	78	62		43	54	78
	Outside built up areas	35 } Ø = 32	42 } Ø = 40	85 } Ø = 84	76 } Ø = 72		41 } Ø = 40	70 } Ø = 67	85 } Ø = 85
	Motorways	42	55	92	77		35	79	92
Turkey	Legislation since 10/84, usage rates not known								

In the Federal Republic of Germany, vehicle-kilometers are assessed for the various categories of road every five years. The most recent figures available are those for 1980. Since the increase in total car kilometers between 1980 and 1983 has been estimated at a mere 2 percent, the 1980 figures were used for the calculations in this paper. The resulting distribution based on a total of 297 thousand million vehicle-kilometers is the following:

66 thousand million vehicle-kilometers on motorways
117 thousand million vehicle-kilometers on roads outside built-up areas
114 thousand million vehicle-kilometers on roads inside built-up areas.

To obtain a fairly accurate risk measure for the car occupants involved, vehicle-kilometers are converted into passenger kilometers by multiplication by the average occupancy estimated for passenger cars (motorways: 1.9; inside urban areas: 1.4; outside urban areas: 1.7).

We thus obtain

160 thousand million passenger kilometers inside built-up areas
199 thousand million passenger kilometers outside built-up areas
125 thousand million passenger kilometers on motorways.

Relating the above data on accident victims to the passenger kilometers just stated, the following rates of accident victims result (number of car occupants involved in accidents per 1 thousand million passenger kilometers):

	Inside built up areas	Outside built up areas	Motorways
Killed	5,4	18,7	4,4
Severely injured	132,9	175,6	38,2
Minor injured	666,6	340,3	124,5
All victims	804,9	534,7	167,1

The results make clear that:

-- the risk of suffering one of the accident consequences above, estimated based on vehicle-kilometers, is lowest on motorways both as regards accident severity and accident victims as a whole;

-- the risk of being involved in an accident as car occupant is by far the highest inside built-up areas;

-- the risk of suffering fatal or major injuries in a car accident is clearly higher on roads outside built-up areas than inside built-up areas.

The extent to which belt effectiveness might be reflected by the true risk figures cannot be determined (inside built-up areas at relatively low speeds: full effectiveness; outside built-up areas at relatively high speeds: limited effectiveness). A glance back to 1970--when usage rates in the Federal Republic were hardly worth mentioning--does not shed any additional light on this factor.

One should beware of deriving the necessity of belt usage from the differences in risk figures, such as, e.g.: belt usage is important inside and outside built-up areas but not so important on motorways. High belt usage rates can only be attained and maintained at that level if belt usage is made compulsory and considered of equally vital importance everywhere without any qualification.

Decreasing use rates?

As far as available, the peak rates of usage measured in a country are shown in Table 1. A knowledge of these rates is of importance for assessing the stability of a high level once it is reached. This question requires observation over a certain period of time, of course, and a final opinion cannot be given at this point. Here too, developments differ from country to country; while there were hardly any decreases in the rates attained, e.g., in Austria, Sweden, Finland and the Federal Republic of Germany, such decreases have been observed elsewhere e.g., in the Netherlands, Denmark and particularly in Norway (inside built-up areas) and Switzerland. However, the downward movement in Switzerland appears to have ceased since May 1983.

Decreasing rates of usage are and will remain to be an undesirable phenomenon, but it should be remembered that present rates in the countries under consideration are still substantially above the levels measured before mandatory legislation took effect: with 67 % (average rate) the rate in Switzerland is 27 %-points higher than at the point when a fine was introduced for the first time (January 1, 1976). In Norway, too, a 40 %-point higher rate is measured inside built-up areas than that measured before mandatory legislation (outside built-up areas: higher by 24 %-points). Nevertheless, decreasing rates have to be regarded as a signal, calling for new incentives, and should be watched for by those responsible for traffic safety policy measures.

Survey methods (cf. Table 2)

In the following overview, the type and scope of the survey methods used are compared. The comparison shows that belt usage is studied exclusively by observing moving vehicles (in slow traffic--complementing studies in the field of accident research are neglected here). The experience with interview or self-reporting methods applied in some countries also indicates that direct observation alone appears to lead to results of acceptable accuracy. In the Federal Republic of Germany, for instance, self-reports and observation data relating to the same driver sample (rural road) varied by more than 100 percent.

TAB. 2: SURVEY METHODS AND VARIABLES MEASURED

COUNTRY	METHODS	VARIABLES
Austria	Since 1974 several nationwide samples annually, number of observations: 15-20.000 cars, vehicles are observed in motion	Seat belt usage by driver, differences in road type, nationals-foreigners
Belgium	Not known	Not known
Denmark	Since 1971 several nationwide samples, number of oberservations: 23.000 cars, vehicles are observed in motion	Seat belt usage by driver, differences in road type
Finland	1. Since 1966 nationwide samples annually, number of oberservations: Inside built up areas: 9.000, outside built up areas: 11.000, vehicles are observed in motion (by police)	Seat belt usage by front seat passengers, inside built up areas, outside built up areas
	2. Special survey in 1978, number of observations: 1.154 (Author: Ovanen, L., Koivurora, M.), vehicles are observed, car passengers were interviewed	Usage rates on front- and rear seats, motorways, inside built up areas, seat belt fitting, condition of seat belts, age, sex, annual mileage, belt system
France	1. Direct observation of 1.062 light vehicles with 1.628 front seat occupants (Onser 1984)	Usage rates on front seats, audience-effect, immatriculation of cars
	2. A study of real car accidents 1970-84, 2.913 belted, 4.339 unbelted front seat occupants (Society of automotive engineers, 1984)	Usage rates on front seats, injury severity, type of impact, seat location, violence, type of belt, ejection, pregnancy
	3. Direct observation of cars in motion 1978-1982 in 20 Departments among 95 in France (SETRA)	Usage rates on front seats, equipment, different road type
	4. Direct observation of cars in motion 1982-1983 in Paris + 6 cities in France (Onser 1983)	Equipment, usage rates on front seats
	5. Questioning 20.000 car owners by AGSAA, September 1983, the usage is reported by the driver	Usage rates on front seats, type of car, age, sex, profession
Germany	Direct observation of cars in motion twice a year since 1975. Number of observation per sample: 20.000 cars	Usage rates on front and rear seats, sex and age of front seat passengers, type of car, equipment with and usage of child restraint
Italy	A first report in Italy by a doctor (Carlo A. Russo Frattasi) with data from 1970-1984. Details are not known	Equipment, usage rates of all car passengers, non usage cost for community, non usage cost for families
Japan	Three times a year some 100.000 drivers and front seat passengers are "surveyed", details are not known	Usage rates of front seat passengers, different road type (expressways, ordinary roads)
The Netherlands	4 days each year direct observation and short interview while stopped at traffic lights, number of observations 6-7.000 p.a.	Usage rates on front seats, equipment Before 1980: age, sex, type of belt, road type, inside/outside built up areas, age of car, length of trip, day of the week Since 1980: road type, age of car, type of belt, day of the week
Norway	One day a year direct observation of cars in motion. 8 sites inside built up areas, 8 sites outside built up areas, number of observation: 15.000 cars inside built up areas, and 6.000 cars outside built areas	Usage rates by drivers
Sweden	1. Direct observation of about 50-100.000 vehicles p.a. in motion (Swedish Road Traffic Safety Office, TSV 1972-81)	
	2. Direct observation of 600.000 vehicles at 50 different sites 1983 (Folksam Traffic Safety Group)	Usage rates by front rear seat passengers (including children)
	3. Most recent study: Direct observation of 60.000 moving vehicles p.a. during a whole week in 1983 and 1984 at 20 sites with different traffic characteristics	Usage rates by all car passengers (including children)
Spain	Direct observation of a 100 cars in each province (50) once a year (near filling stations outside built up areas)	Usage rates of front seat passengers
Switzerland	One direct observation of 20.000 moving vehicles each year	Equipment, usage rates by drivers, road type, three geographical areas (German Switzerland, Western Switzerland, Tessin)
Turkey	Not known	Not known

TAB. 3 Survey timetable and No. of cars to be observed in each region, with a breakdown of types of roads, in the Fed. Rep. of Germany (from 1976)--(twice a year, in four regions of the Fed. Rep.)

I. Overall Survey Timetable

Type of road	Observation days and no. of cars to be observed							Sum total of cars/all days of observ.
	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.	
Inside urban areas	700	700	700					2.100
Motorway				700			700	1.400
Outside urban areas					600	600		1.200

II. Daily Survey Timetable

Type of road by type of traffic and direction of travel		Daily observation hours and no. of cars to be observed											Sum total of cars/day
		7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	
Inside urban areas	To and from work trips	70	70								70	70	280
	Shopping				70	70	break			70			210
	Long distance traffic			70				70	70				210
Motorway	Both lanes	70	70	35				70	70	35			350
	Roadway for opposing traffic both lanes			35	70	70	break			35	70	70	350
Outside urban areas	Both directions	60	60	60	60	60	break	60	60	60	60	60	600

In most (if not all) countries belt usage surveys are conducted regularly and time series on long-term user behavior are available. As it was soon discovered that usage rates vary considerably inside and outside built-up areas and on motorways, many countries have attempted to take account of this phenomenon by distributing counting sites accordingly. Such distribution is also hoped to lead to fairly representative data on belt users for a country as a whole.

Some countries (see for example Table 3) schedule counting sites and times to additionally take account of variables such as trip purpose (recreational, shopping, to-and-from-work trips, etc.) and times of travel (weekdays, weekend, seasons of the year).

User characteristics

In some countries the usage behavior of drivers only is studied, other countries additionally study variables such as age and sex of drivers, occasionally also of front seat passengers, since personal data of this nature are regarded as important for behavioral studies. In addition to the individual, the car is of interest. Are belts used more often in big cars (in terms of engine displacement) than in small ones? How do older cars compare with newer ones? There are finally indications that occupancy (number and type of passengers) also effects belt usage (the so-called audience effect). All these variables are briefly described below.

Drivers and passengers

Only few countries also measure the usage behavior of front seat passengers (or report on it). This may be explained by the slight differences measured in the belt usage of these subjects. In Austria, for example, passengers are reportedly no longer observed for some years because no differences have been measured between the usage rates for drivers and passengers. In Spain too no differences between the rates of usage for drivers and passengers have been found. In Norway rates of usage for front seat passengers have been found to be 3 percent higher.

In the Federal Republic of Germany, the belt usage rates for passengers have been slightly higher (2 - 4 %-points) than those for drivers for some time. Once rates of usage of 90 percent and more are attained these differences can no longer be detected.

Age

In the Federal Republic of Germany, driver age levels (20, 25, 30 years, etc.) have been additionally recorded in the belt usage studies performed inside built-up areas. The error of estimation is not known. But the estimates revealed the following trend: between 1976 and 1981 there was a shift (occasionally by 10 %-points and more) from the younger to the older group of drivers with the youngest (aged 20 years) often displaying the highest rates of belt usage. From 1981 this difference has slowly been disappearing. Recently, another striking phenomenon has been noticed -- the surveys indicate a reverse in trends -- no longer the youngest but elderly drivers are now the most frequent users. Compared with that, the age level of 20 years appears to have switched to a more negligent attitude.

A Finnish study (1) also reports generally higher rates for elderly drivers; the largest behavioral difference has been reported for urban areas: the user population among younger car drivers (age level of 20 years) has been estimated at 50 percent or less than that in the age group of 30 - 49 years (17 percent compared with 47 percent).

The user data reported in a French study (4) confirm the findings displaying middle-aged drivers as the population with the highest user frequency.

Sex

The belt usage differences measured in some countries between male and female car drivers are not uniform. For Finnish motorways rates of 71 percent were measured for men and 75 percent for women. On roads inside built-up areas women have been belted considerably more frequently (58% than men (38%).

A poll of 20,000 drivers taken in France (4) between 1975 and 1980, which indicated a general change in trends compared with previous self-reports, did not reveal anything indicating a noticeable difference between the rates of male and female belt users, although general usage behavior varied widely:

	I WEAR MY BELT			
	ALWAYS (in %)		NEVER (in %)	
	1980	1975	1980	1975
Male	71.1	34.2	8.0	34.3
Female	70.6	35.4	8.6	34.4

All studies on belt usage in the Federal Republic of Germany over the last years did not reveal any measurable difference between the behavior of men and women on motorways, although slightly higher rates of belt usage for women were measured in most counts. The counts taken on roads outside and inside built-up areas in the years before mandatory belt usage legislation took effect (until 1979) also did not show anything indicating sex differences in belt usage behavior. In the eighties, however, belted women have been observed more frequently than men. But the largest difference measured was not higher than 7 %-points.

On the whole the studies do not permit any systematic conclusions as to the effect of sex on belt usage behavior.

Different population groups

The population group to which drivers belong is also a personal variable. Switzerland provided excellent data material on this point. The survey method used in Switzerland was specially designed to take different population groups into consideration--in Switzerland also with respect to language--and the rates measured are grouped accordingly into data relating to German Switzerland, Western Switzerland and Tessin. The rates of usage for drivers which were measured in May 1985 (in %) are shown in the table below and are a good example of the behavioral differences between population groups and the impact of such differences on average rates of belt usage on a nationwide basis:

Motorways			Outside built up areas			Inside built up areas		
G.Sw.	W.Sw.	Tessin	G.Sw.	W.Sw	Tessin	G.Sw.	W.Sw.	Tessin
85	69	51	77	55	37	63	34	19

Reasons for nonuse (Federal Republic of Germany only)

With the decidedly high usage rate of more than 90% it seems futile to speculate about the personality or behavioral reasons possibly accounting for the remaining 8 - 10% of nonusers: apart from the "hard core" of belt opponents there are the negligent ones or the ones who simply forget. Things were different when usage rates had been low. Then considerable efforts were invested in pinpointing the various reasons for nonuse in order to try to raise usage rates by means of target group specific information and appeals.

Many studies repeatedly revealed considerable gaps in knowledge on the part of drivers with respect to belt effectiveness, imagined detrimental effects (cf. Table 4) and legal position. For example, in 1980, 57 percent of drivers in the Federal Republic of Germany still believed belt use to be a recommended practice, not mandatory. The situation considerably improved at the beginning of 1985 (six months after introduction of the fine). Now this question is answered correctly by about 85 percent of private car drivers.

As regards the safety belt, there are also psychological factors which play a role. Based on their psychoanalytical studies performed for BASt, DELLEN and BERGER cautioned at an early point that many drivers do not associate the belt primarily with protection but with danger and accidents. Reaching for the belt invariably calls to mind an accident. That is why the belt is not only rejected verbally but also in fact (5). The problem therefore is the distinction between the resistance put up for justifiable psychological reasons and mere protective claims.

However, that such resistance does not require draconian measures to be overcome is evidenced by the usage rates on motorways which have always been quite high; and also by the improvements in usage rates brought about by the introduction of the (still quite reasonable) fine.

Table 4: Opinions on belt effectiveness in case of accidents*) (in %), November, 1980

Statement	tendency to say yes	tendency to say no	no answer
if one is belted it is difficult to get out of the car if it catches fire and one can burn to death	55	44	1
if one is belted one can easily break one's neck in an accident	23	76	1
in an accident it is better to be thrown out of the car than to be restrained by the belt	27	73	1
one is tied down by the belt and cannot do anything in case of an accident	32	68	-
the belt can cut into the body in an accident	24	75	1
one can be strangled by the belt in an emergency	39	61	-
in an accident first aid people often do not know how to release the belt, which can be a great danger for the occupants	52	48	-

*) n = 1,021

Other variables observed

Audience effect

Some countries (e.g., United Kingdom, France, Federal Republic of Germany) report differences in the rates of belt usage for drivers when other occupants are present (the so-called audience effect). In the Federal Republic of Germany, e.g., the rates for drivers have been found to rise slightly in the presence of front seat passengers. The difference is even higher when a women is in the seat. Some counts on motorways show differences of more than 10 %-points. The differences measured outside and inside built-up areas are slightly lower. In France 72,2% of drivers were belted in the presence of occupants where as only 51,1% were observed to be belted driving alone.

Vehicle

With respect to the effects of vehicles on belt usage behavior it has been suspected that these effects may be caused by the following two factors: age of a car (and the associated "age" of the belts installed) and size of a car.

A Finnish (1) study revealed no differences between the rates of belt usage inside built-up areas, based on the age of vehicles. On motorways, however, the rates measured for new cars were 12 %-points higher than those measured for cars of "middle" age and 16 %-points higher than for old cars.

A survey conducted in the Federal Republic of Germany in 1975 also showed a higher rate of usage for automatic belts compared with inertia reel belts (the type of belt is considered as indicating vehicle age). Compared with the rates for inertia reel belts, the rates of usage for automatic belts measured inside built-up areas at that time were higher by 6 %-points and higher by 15 %-points on roads outside built-up areas and by 14 %-points on motorways.

The size of vehicle (in terms of engine displacement) also appears to affect the levels of belt usage. In the Federal Republic of Germany the highest rates of usage inside built-up areas have been measured for cars in the lower medium size range. Increasingly lower rates have been measured for the bigger cars. The lowest rates have resulted for sports cars. The rates obtained for drivers of small cars range somewhere in between.

Annual vehicle mileage

The Finnish study, which has been cited already several times in the preceding chapters, also reports different rates of usage depending on the level of annual vehicle kilometers of drivers. Rates of belt usage on motorways are noticeably lower for drivers with a high and low annual Vehicle-kilometer level than for drivers with an average level. Measurements inside built-up areas revealed that the rate of usage tends to go down as annual vehicle-kilometers increase. This may possibly be explained by the fact that women--who showed up as more frequent users--tend to drive less and mostly inside built-up areas on an annual basis.

Time of day

Belt usage at nighttime is the last variable in this connection as it may significantly affect accident consequences, that is to say belt usage at a time when approximately 40 percent of all fatal accidents occur in the Federal Republic of Germany, for instance.

Nighttime studies are problematical and only possible at illuminated sites and low speeds. Therefore few data are available on the level of belt usage at night.

In France a difference of 25 %-points was measured inside built-up areas (daytime: 60%; nighttime: 36%). A (non-representative) count inside built-up areas undertaken by the Federal Republic of Germany in March 1984 revealed rates of 53% for drivers during the day and 42% at night and for passengers in front seats 51% during the day and only 41% at night.

Condition and correct usage of seat belts

The effectiveness of the belt can be considerably impaired by shortcomings in belt functioning and/or incorrect usage. Manufacturing or handling mistakes can generally no longer be accurately identified when accidents are reconstructed. The variables affecting the "quality of usage" can only be determined at considerable costs by stopping drivers, measurements and/or observation and self-reports. Full-scale studies on these questions are therefore not available, but individual studies revealed the following findings:

1. A Finnish study (1) reports on belt condition and incorrect usage practices based on measurements in 1,145 passenger cars. Only 18% of all belts were found to be in good condition or correctly fastened. The rate of 25 percent in the case of automatic belts was considerably higher. Shortcomings of this nature impair the protective effect of the belt to a varying degree. The study concludes that the effectiveness of automatic belts is impaired by 35 percent of the shortcomings in belt functioning and incorrect usage practices measured and static belts by 69 percent of such inadequacies. Taking these reductions of effectiveness into consideration, and based on the rates of usage in Finland at that time (58% for automatic belts and 47% for static belts), only 38 percent of the automatic and 9 percent of the static belts can be considered as fully functioning.

2. An ad-hoc working group of experts from France and the Federal Republic of Germany dealt especially with the question of submarining (2) which apart from the design of car seats essentially depends on the quality of belt usage (belt geometry, belt slackness, "relaxed-seating-position"). Based on two independent studies, the group arrived at the conclusion that submarining has been the cause of 5% of all injuries to belted car front seat passengers. Although the frequency appears to be low, injury severity has been considerable. The comparison of women and men did not show any important differences. Front seat passengers appear to be at a higher risk of submarining than drivers, and passengers using static belts appear to be more exposed than those using automatic belts.

3. In 1983, an accident research team checked 785 cars equipped with three-point automatic belts in the Federal Republic of Germany (3). The study covered 785 drivers and 221 front seat passengers. The quality of belt usage was checked based on the following criteria:

    - position of belt in the shoulder area
    - position of belt in the pelvis/abdominal area
    - slack points in belt systems
    - belt system particularities
    - driver (sternum) to steering wheel center distance
    - passenger (sternum) to dashboard distance
    - physical characteristics of occupants (height, weight)
    - car (type, year of production)
    - seating position (driver or front seat passenger).

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The study concludes that an estimated total of 42 percent of all belt users observed in moving vehicles wore belts that were not in proper position. The resulting damage to belt effectiveness was not assessed.

Despite the difference in approach, and in the research findings arrived at in the three studies above, the results indicate that manufacturing shortcomings, and especially incorrect belt usage, can greatly impair the effectiveness of belts. That is why, not only the absolute rate of belt usage, but also the quality of belt usage, play a considerable role.

Are there any external indicators (economic etc.) permitting forecasts of changes in rates of belt usage?

A glance at the variables generally measured (cf. Table 2) makes clear that these variables have been selected to explain differences in belt usage behavior (e.g., according to age and sex) but not as variables permitting forecasts of changes in belt usage rates. Correlations with other variables, e.g., economy, are not known.

Increases in the rates of belt usage owing to mandatory legislation and severe sanctions can today be estimated based on the experience acquired on an international basis (cf. Table 1: Before/after differences). The increases are considerable even though the usage rates differed before belt usage was made compulsory and the resulting rates of increase differ also.

Conclusion

In all countries the introduction of mandatory usage has led to considerable increases in belt usage rates (between 40 and 65 %-points). While there were hardly any decreases in the rates attained, e.g., in Austria, Sweden, Finland and the Federal Republic of Germany, such decreases have been observed elsewhere, e.g., in the Netherlands, Denmark, Norway and Switzerland, but the present rates in these countries are still substantially above the levels measured before mandatory legislation took effect.

It is not possible to derive any clues of value for special incentives from the majority of the variables assumed to have effects on seat belts usage (age, sex, size of car, etc.). However, the differences observed in almost all countries in the rates of seat belt usage on roads associated with different risk levels, possible differences in the behavior of different population groups (Switzerland) and the differences in the nighttime rates of usage are of special interest in this connection. A greater attention may also have to be paid to the quality of belt usage.

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SAFETY BELT USE RATES AND USER CHARACTERISTICS

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USE RATES BEFORE AND AFTER BELT USE LEGISLATION

The effects of legislation on safety belt use rates can be examined in five countries and fifteen different administrative jurisdictions. Table I summarizes the information, showing for each jurisdiction the available information on pre-legislation and immediate post-legislation use rates for drivers, together with the most recently-reported rates and the number of years since legislation that they represent.

It will be seen that pre-legislation use rates were as low as 4%, 8% and 11% in three Canadian jurisdictions, and as high as nearly 40% in the UK and in British Columbia; but were otherwise around 20-25%. The immediate post-legislation rates were in all cases substantially higher, but differed considerably by jurisdiction. At its lowest, the use rate in the province of Quebec was only 36% after legislation, and both Ireland and New Jersey achieved only about 40%. At the other extreme, a rate of 93% was observed in the UK.

Longer-term experience with the laws has also brought different results to different jurisdictions. In Australian States and in New Zealand, the rate of belt use has increased during the post-legislation period, and stands recently at about 90%, after a decade or more of life under the law. The State of Victoria, which led the world in applying the law, has the highest average driver belt use in the world of 96%, after 13 years under legislation. Use in the UK was also sustained at its extremely high level two and a half years after enactment of the legislation.

Canadian jurisdictions show rather less success with the laws. Belt use has generally been observed to decline after its immediate post-legislation peak, and stood for example at only 62% in Ontario, 8 years after legislation, and 50% in Saskatchewan, 7 years after legislation. The best long-term achievement has been in British Columbia, where driver use had risen to 69%, 7 years after legislation.

SAFETY BELT USE RATES

The use of safety belts by motor vehicle occupants can be determined through direct observation at the road-side, through self-reports and through reports by police officers investigating accidents. While it is generally accepted that direct observations provide the most reliable estimates of safety belt use, reported belt use, by either self or third party, can often provide useful information as well.

TABLE 1: PROPORTIONS OF DRIVERS WEARING SAFETY BELTS, WHERE AVAILABLE

COUNTRY/JURISDICTION	Pre-legislation belt use (%)	Post-legislation belt use (%)	Most recently observed use (%)	Date of last survey	Years since legislation
AUSTRALIA :					
- Australian Capital Territory			82	1983	11
- New South Wales	19	76	89	1983	11
- South Australia			91	1982	10
- Victoria	20-25	75	96	1984	13
- Western Australia			87	1978	6
CANADA :					
- British Columbia	40	60	69	1984	7
- Manitoba	11	62	62	1984	<1
- New Brunswick	4	67	60	1984	1
- Newfoundland	9	68	70	1984	2
- Ontario	24	77	62	1984	8
- Québec	20	36	54	1984	8
- Saskatchewan	25	57	50	1984	7
IRELAND :					
- National roads	19	46	46	1979	<1
- Other roads	9	38	38	same	
NEW ZEALAND		83	91	1983	11
UNITED KINGDOM					
- Overall	37	93	94	1985	2
- Motorways	52	97		1984	
- Urban minor roads	27	92		1984	
UNITED STATES					
- Michigan	20	61	61	1985	< 1
- New Jersey	18	40	40	1985	< 1
- New York	16	57	57	1985	< 1

While self-reports tend to over-represent use, they are nevertheless significantly correlated with actual usage (Mayas et al., 1983; Stulginskas and Pless, 1984; Waller and Barry, 1970). Hence, self-reports are acceptable in correlational studies which assess the factors influencing the use of belts, since it is very difficult to gather these attitudinal and motivational data at the roadside. Police-reported belt use is often biased in favor of use by the motor vehicle occupants involved in an accident. In many cases, the police give the occupants the benefit of the doubt or even ignore non-use, particularly if the occupant was injured. Police officers are reluctant to charge people who have not worn their belts in these situations, perhaps believing that the injury was sufficient punishment.

Studies of safety belt usage rates reported by various OECD member countries will be reviewed in turn alphabetically distinguishing them on the basis of the three methodologies noted above. In this section, only situational variables related to belt use are included. The characteristics of safety belt users and non-users are treated separately in a subsequent section.

AUSTRALIA

Boughton, Milne and Cameron (1980) have reported on a series of safety belt use surveys that have been conducted between 1973 and 1978. In the most recent of these surveys (July, 1978) passenger cars and derivatives were observed at five or six sites in each of the cities of Adelaide, Melbourne and Perth. Each site was at a signalized intersection on an urban arterial road with a central median, heavy traffic flow, and well-lit at night. The sites were believed to give a reasonable representation of each city. The first vehicle stopped at the traffic light in the lane close to the median was observed. However, if there were two or more eligible vehicles stopped, then the observer selected whichever of the first three vehicles had children. The observations were conducted between 0600 and 2400 hours, Thursday through Sunday. The observers recorded seating position, type of restraint fitted, restraint use, sex and age-group of occupant, and proper safety belt use. One observer recorded information for front-seat occupants whereas a second observer noted the information for rear-seat occupants.

In the July 1978 survey a total of 14,283 occupants were observed, in 7,841 vehicles. Of drivers, 99% in Melbourne and 93% in each of Perth and Adelaide had a safety belt available. These proportions were almost the same for front outboard passengers; but were much lower for center front passengers (about 50% in Melbourne and Perth, but 30% in Adelaide); and for rear passengers (65% in Adelaide, 70% in the other two cities). Among those occupants with a belt available, belt use for all seating positions was 77% in Melbourne, 76% in Adelaide and 81% in Perth. For drivers only, these proportions were 85%, 82% and 87%. However, use rates for rear-seat passengers with belts available were under 40% in outboard positions and under 20% in the center seat.

Boughton found that over the Period 1973 to 1978, belt use was slightly higher on weekdays (81%) than on weekends (79%). Belt use was also higher during the daytime (81%) than at night (78%). Belt use was unrelated to weather conditions.

Misadjustment of belts was observed to be common: for front outboard occupants using "static" lap-shoulder belts, less than 20% had the correct adjustment.

Surveys have also been conducted by the state governments in Australia, as follows:

SOUTH AUSTRALIA

A November, 1982 survey by the Road Traffic Board of South Australia (1983) was performed to assess the impact of a public education campaign on safety belt use. It was conducted at ten signalized intersections in the Adelaide Metropolitan Area which had wide central medians, and lights with red phases sufficiently long to permit the observations to be made. The first three eligible vehicles (cars, station wagons, vans, four-wheel drives) to stop at the light were included in the sample. Observations were made either between 0700 and 1000 hours or between 1500 and 1800 hours to cover both rush-hour periods. In November, 1982, 3796 vehicle occupants were surveyed in 2794 vehicles. A safety belt was available for 97% of drivers, 95% of front-seat passengers, and 88% of rear-seat passengers. Where belts were available, use was 91% among drivers, 85% among front-seat passengers and 61% among rear-seat passengers.

NEW SOUTH WALES

Twenty-five surveys of safety belt use conducted in New South Wales between 1970 and 1981 have been described by Schnerring (1983). The survey methodology evolved over the years, so it is impractical to describe more than the major features. Between 1970 and 1974, ten surveys were undertaken, at 1-5 sites in the Sydney Metropolitan area. Starting in 1975, the survey was expanded to include 19 locations in that area. An additional three surveys were made in rural areas, in 1976, 1979 and 1981.

Of the 12 surveys made in the Sydney Metropolitan area between 1975 and 1981, one was made in July in each of the seven years, allowing annual comparison. Surveying took place during one week, representing all days of the week, and each site was normally surveyed during a two-hour stint selected between the hours of 0630 and 2130. The sites and times were chosen to represent five major traffic types: morning and afternoon commuting, weekday and weekend recreational trips, and shopping. Two observers at each site sampled cars or car derivatives while stopped at traffic lights, toll gates, or in shopping centers. Safety belt use by adult passengers in outboard seating positions was recorded. The number of observations made in the recent surveys can be typified by that done in July 1981, with 16,746 vehicles, 24,786 front-seat occupants and 1,281 rear-seat occupants.

In the 1981 survey of vehicles in the Sydney Metropolitan area, 99% of front-seat occupants had access to a safety belt while 88% of the rear-seat occupants had a belt available. Driver belt use in 1981 was 84%, while front-seat passengers' use was 75% and rear-seat passengers' use was 26%. Correct safety belt use was 76% for drivers, 70% for front-seat passengers and 24% for rear-seat passengers. Weekday recreational trips (most of which were night-time trips) showed belt use among occupants of only 73%, while use during the other trip types was 81% to 83%.

For the rural areas of New South Wales that were surveyed, it was found that 99% of front-seat occupants had access to a safety belt compared to 84% for rear-seat occupants. In July, 1981, 80% of the drivers were using belts compared to 74% for front-seat passengers and 24% for rear seat passengers. About 73% of drivers were using the belts correctly compared to 68% for passengers in the front seat and 23% of rear seat passengers. Obviously, safety belt use is considerably higher in the city (i.e. Sydney) than in rural areas. Average occupants use was only 72% at night compared to 76% overall at the rural sites.

AUSTRALIAN CAPITAL TERRITORY

Pederson and Mahon (1983) have reported on a roadside survey of safety belt use which included interviews with drivers. The 17 survey sites which were either in or near Canberra were located at a service station, fast food outlet or a parking lot for a shopping center. Some of the observations of seat belt use were conducted at signalized intersections. The survey was performed in 55 three-hour stints, during all seven days a week, between 0900 and 1845 hours.

There were two observers at each site, one person doing observations while the other conducted the interviews. The person doing the observations selected the first vehicle to enter and once that observation was completed they selected the next vehicle to enter. In order to get equal numbers of interviews with wearers and non-wearers of belts, the latter group was over-sampled by the interviewer.

A total of 6503 occupants were observed, in 4167 vehicles, and interviews were conducted with 710 drivers. Belts were found to be available to 99.4% of front outboard occupants and 92.32% of those in rear outboard positions. Analysis revealed an overall belt use rate of 77% among those occupants with a belt available. Among drivers alone, this rose to 82%, while it was slightly lower among front-seat passengers, giving an overall front outboard position use rate of 75-80%. In rear outboard position the equivalent rate was 30-40%.

Pederson and Mahon found in addition that belt use was about 7% higher when inertia-reel belts were available rather than static belts. They found that use was very slightly higher on weekends than weekdays, but otherwise did not vary significantly by time of day. They showed that belt use differed between the different types of site at which the surveying was done; and also that it was about 6% higher when the road was wet than in dry conditions.

VICTORIA

The Road Traffic Authority of Victoria has undertaken numerous surveys of belt use since this jurisdiction became the first to pass compulsory use legislation in December, 1970. Eleven such surveys between 1971 and 1980 are described in Milne (1980), and the most recent reported survey, in March 1984, is described in Manders (1984).

This latter survey was conducted at 14 sites in the City of Melbourne, and three sites in regional cities. Sites were at signalized intersections on arterial roads with central medians, relatively heavy traffic flow and good lighting. Sites were stratified to represent 4 types of traffic in Melbourne: "peak-hour"; "recreational"; "local"; and "long trip", with "rural cities" providing a fifth stratum. Two observers at each site sampled cars, car derivatives and passenger vans, recording seat belt availability and use for all occupants, oversampling rear-seat occupants.

A total of 6744 occupants were observed, in 3471 vehicles. Safety belts were observed to be almost universally available for front-seat occupants, and available for 95% of rear-seat occupants (though this includes child restraints for 55% of rear center occupants).

Of those with belts available, 85.3% of all occupants were restrained. By seating position, the proportions were 95.9% for driver, 92.1% for front-seat passengers, 58% for rear outboard passengers and 79% for rear center passengers (including child restraint use). The use proportions were found to be lower in the evening, and particularly after midnight (68.3% among all occupants, vs. the average of 85.3%). Use was highest on "local" trips (89.1% for all occupants), and "peak-hour trips" (87.6%), and lowest on "recreational" trips (79.1%). Use was also found to be higher in cars (89%) than in passenger vans (63%); and reached its lowest among the passengers in taxis (39%).

CANADA

National observational surveys of seat belt use have been conducted in Canada every year since 1975 with the exception of 1976 and 1978 (Arora and Lawson, 1982; Arora, 1983, 1984, 1985). The most recent survey (Arora, 1985) was conducted in November, 1984 at 200 sites across the country. A stratified multi-stage probability sample design was used in the survey. The sampling universe included drivers in private automobiles with Canadian license plates travelling over the appropriate road types during the survey week. Recreational vehicles, trucks, jeeps, vans etc. were excluded. The sample population was stratified by province (ten provinces), and by size of population centers (centers with population 100,000 or greater, 50000-99999, 10000-49999, 5000-9999, rural). Within population centers, roads were classified according to type (ie. expressway, highway, major arterial). Roads were then selected with equal probability without replacement. For each selected road, all road segments controlled by either traffic lights or stop signs and having sufficient traffic volume were listed and then one of these road segments was randomly selected. Finally, the direction of the traffic to be observed was chosen at random.

The survey was conducted for seven consecutive days, between 0730 and 1630 hours for Monday to Saturday and between 1300 and 1700 hours on Sunday. For each selected site, two time periods were randomly selected without replacement.

The observers stood at the roadside, usually on the driver's side, and noted whether drivers were wearing a shoulder belt. Vehicles with a detachable lap belt for the driver's seating position comprised only 2% of the sample, so that the failure to observe lap belt use introduced only a slight bias in the usage rate. The observers started by observing the driver in the first vehicle stopped at the red light or the stop sign and then walked down the line of traffic observing as many drivers as possible before the vehicles started moving. The traffic flow at each site was also counted and recorded.

In order to generate national estimates of seat belt use, the data were weighted by traffic flow to represent population centers, and then by population to represent provinces and the nation as a whole. Based on the 38,086 observations made in 1984, it is estimated that 53.7% ± 2.9% of Canadian drivers were using a shoulder belt. Belt use was highest in British Columbia (69.4%) and lowest in Prince Edward Island (9.1%). In seven provinces with safety belt use legislation, 60.1% of the drivers were belted compared to 19.2% for the three unlegislated provinces. Belt use was somewhat higher at urban (54%) than at rural sites (46%) but there was no effect of weather conditions. Within the 98% of cars equipped with shoulder belts, use averaged 54.9% nationally, 61.5% in the provinces with legislation, and 19.6% in those without legislation.

An earlier study by Arora and Lawson (1982), based on surveys conducted between 1975 and 1981, revealed no differences as a function of rush-hour versus non-rush hour or weekday versus weekend. The 1979 survey, however, indicated that belt use was somewhat lower at night compared to the daytime, although the difference was significant in only one community. Belt use was observed to increase as vehicle size decreased, and drivers of newer cars were more likely to be using seat belts. Based on the 1977 and 1979 surveys, it was concluded that belt use was higher among drivers of "imported" cars than among drivers of North American produced cars.

Jonah and Dawson (1982a) asked 2047 people how frequently they wore safety belts during the last ten trips under various conditions. Respondents were more likely to use safety belts as a driver (64.5%) than as a passenger (56.8%) and they were less likely to use belts on local trips (55.7%) than on highway trips (69.2%). Overall conditions, motor vehicle occupants reported using safety belts during about 60% of the trips. As in the observational survey (Arora, 1985), use was reported to be considerably higher in those provinces with safety belt laws (70.7%) than in those without such laws (24.3%). Given that the observed percentage of drivers wearing belts in 1981 was 38.1%, it is clear that self-reports over estimate actual use. In another household survey primarily concerned with impaired driving, 2000 respondents were asked about safety belt use (Wilson, 1984). Nationally 53.3% of the drivers reported that they always wore a belt whereas 26.2% said they never wore one.

In addition to national surveys conducted by the federal government, provincial governments have also performed surveys to monitor belt use. These provincial surveys are reviewed below.

NEWFOUNDLAND

An observational survey is performed during the daytime (0700-1530), at 13 sites throughout the province, about 2 or 3 times each year. The sites are representative of urban and rural roads, business and shopping locations, and include highways as well as city streets. All vehicles are included with the exception of heavy trucks. The most recent survey conducted in July, 1984 revealed that of the 3800 drivers observed, 73.9% ± 3% were wearing a safety belt (Murray, 1984). This use figure is quite consistent with that reported by Arora (1985) for Newfoundland in the 1984 national survey (69.7%).

NEW BRUNSWICK

Monthly surveys have been conducted since September 1983, to monitor the impact of the safety belt legislation on belt use. These surveys have been conducted at 15 sites throughout the province, chosen to represent both urban and rural roads. The most recent survey of 1511 drivers in August, 1984 showed that 73.2% were wearing belts (New Brunswick Department of Transportation, 1984). This is consistent with earlier provincial surveys which show belt use is in the 70-75% range. However, it is considerably higher than the 60.2% observed in November, 1984 in the national survey (Arora, 1985).

QUEBEC

A very large observational survey was undertaken in Quebec in June, 1983. Drivers and front seat passengers in cars were included. Sites were selected in 26 cities with populations over 20,000 and along 4 freeways and 2 major highways. It is unclear how many of these sites represented rural roads. The 104,000 observations were conducted between 0730 and 1530 hours at street corners in the cities and from overpasses which crossed the freeways and highways. While the freeway and highway observations were obviously performed with the vehicles in motion, it is unclear whether the city observations were conducted with the vehicle moving or stopped. Belt use for drivers was higher on the freeways and highways (73.9% ± 0.7%) than on urban streets (60.1% ± 0.6%) as was the case for passengers (65.5% ± 1.2% vs. 52.0% ± 1.1%). Drivers were more likely to be wearing safety belts than passengers. Belt use also appeared to be high at rush hours compared to non-rush hours.

ONTARIO

The Ontario Government has conducted roadside surveys of driver and passenger safety belt use every three years since 1978 and yearly between 1975 and 1977. A three stage sampling plan has been used for the survey, with areas of the province selected first, then sites within areas and finally drivers at sites. The 66 sites represent large and small communities and are representative of travel on urban streets, and expressways as well as major and minor provincial highways and country roads. The surveys are conducted during daylight hours, although the specified times are not indicated. Unlike other surveys, the target automobiles are stopped by the chief of the survey crew and directed into the survey site where belt use is observed and the driver is interviewed concerning safety belts and child restraints.

The most recent Ontario survey, conducted in May, 1984, found 70% of drivers were belted (MTC, 1985). This is somewhat higher than was estimated for Ontario (61.9%) in the national survey (Arora, 1985).

Police officers investigating traffic accidents in Ontario indicate on the accident report form whether the vehicle occupants were wearing safety belts at the time of the accident. In 1983, 81.8% of the drivers involved in accidents were reported by the police to have been belted at the time of the accident. Among fatally-injured drivers, where belt use is likely more reliable, only 30% were reported to have been wearing belts (Ontario MTC, 1984).

MANITOBA

The provincial government started conducting safety belt use surveys in February, 1984 to monitor the impact of the safety belt legislation that went into effect in January, 1984. A total of 16 sites were observed with most sites being located in urban areas. In the most recent survey conducted in June, 1984 (DataCom, 1984), 79.1% of the 6459 observed drivers were wearing a safety belt, which is considerably higher than the use subsequently observed in the national survey in November, 1984 (61.6%). This perhaps reflects a decline in the use of belts from a post-legislation peak.

SASKATCHEWAN

Safety belt use has been monitored since 1977 at 70 sites which represent the urban and rural road systems within the province. The surveys were conducted between 0700 and 2100 hours over a 10-day period. The drivers were stopped so that they could be interviewed about safety belt usage, as well as to have their belt use observed. Based on about 4000 observations in the most recent survey, in 1982, it was estimated that about 63% of drivers were using safety belts (Anderson, 1982). That is considerably higher than the figure of 48.4% obtained in the national survey in November of that year (Arora, 1983). An earlier study by Bergan, Watson, Rivett and Shiels (1979) found that occupants in vehicles with a safety belt warning buzzer were more likely to be wearing safety belts. Belt use was observed to increase with model year and decrease with vehicle size.

BRITISH COLUMBIA

Surveys were initiated in the province of British Columbia in March, 1977 in order to evaluate the impact of the provincial safety belt legislation. These surveys have been conducted in only eight cities and hence do not represent rural travel. In the most recent survey, 19 sites were observed during three separate time periods, representative of weekday rush-hours, weekday non-rush-hour and the weekend. At 12 sites with higher traffic flow, the length of these observation periods was one hour, whereas at sites with a lower traffic flow, the length was two hours.

The belt use of 6201 vehicle occupants was observed in March, 1982. Belt use for drivers was 54%, while only 40% for passengers (Western Analysis, 1982). However, the right front-seat passenger, which had access to a three-point belt, was much more likely to be belted (46%) than other passengers (middle front-29%, rear left-30%, rear right-31%, rear middle-26%). There was a general trend showing that driver and passenger belt use decreased as a function of vehicle age. Driver and passenger use was also higher in the larger cities (62% and 53%) than in the smaller cities (44% and 39%).

In June, 1983, the methodology of the British Columbia survey was altered in order to better represent urban, suburban and highway driving, various socio-economic levels and cultural mixes as well as service, excursion and commuter traffic (B.C. Research, 1983). Within each of the 28 police jurisdictions, three sites were selected and observations were conducted at each site for a total of six hours over a two day period. In addition to observing the use of belts by the occupants, drivers were interviewed about belts. This survey was conducted primarily to evaluate the province-wide "80% Clicks" program, which consisted of public education and police enforcement activity to promote belt use. Prior to the May campaign, 55% of occupants were belted. Overall, 67% of the 8900 occupants were observed to be wearing a safety belt in June, 1983. Drivers were more likely to be belted (73%) than passengers in the center front (37%), right front (64%), rear left (51%), rear center (37%) or rear right (50%) seating positions.

Mercer (1983) has reported belt use among British Columbia vehicle occupants involved in motor vehicle accidents. For the most recent year available (1982), 58.3% of the occupants were reported by the police to have been wearing safety belts at the time of the accident.

In summary, seat belt use by Canadian motor vehicle occupants is frequently monitored federally and provincially. Federal and provincial use rates do not always correspond due to differences in sampling, observational procedures and the time period during which the survey was conducted. Nevertheless, it is clear that about 55% of Canadian drivers are using seat belts and that the use rate is considerably higher in provinces with seat belt use laws (61.5%) than in provinces without such laws (19.6%).

IRELAND

Two small scale surveys were conducted in Ireland during 1978 and 1979 in order to evaluate the impact of legislation on safety belt use (Hearne, 1980). A subsample of the sites used in a larger exposure survey were used in the survey, but only rural sites were included. Belt use was observed during the daytime for several hours at each site. The belt use of 813 drivers was recorded in 1978 at a total of 20 sites in several counties; whereas in 1979, 1230 drivers were observed at 22 sites around Dublin. As of 1980, 100% of cars were equipped with belts in the front but only about 5% had belts installed in the rear seating positions. In 1979, driver belt use on the National Roads was 45.7% ± 3%, and on other roads was 37.6% ± 8.0%. For front-seat passengers, belt use was 52.1% ± 5.2% on National Roads and 47.9% ± 12.5% on other roads.

NEW ZEALAND

Safety belt use surveys have been conducted in New Zealand since 1974 (Appleton, 1983, 1984; Torrington and Hull, 1981). These surveys have been conducted in the three major cities of New Zealand: Auckland, Christchurch and Wellington. Two sites were sampled in each city, one within the city and the other outside the city. The observations were made outside the rush-hours during weekdays. The target vehicles (all those requiring fitment of safety belts) were stopped at random by a traffic officer. As Appleton (1984) points out, this procedure may have introduced a bias since non-users may have put on their belts prior to being observed or they may even have refused to participate. The observer noted occupants' seating positions, availability of safety belts, proper use of the belts (ie. good, bad, not used) and sex. In order to assess proper use of seat belts, the adult occupants were asked to put their thumb under the shoulder belt and push it forward. If the amount of movement was judged to be greater than a handwidth (about 10 cm), then the belt use was categorized as bad. Unbuckled belts draped over the occupants shoulder were considered to be unused.

In the 1983 survey (Appleton, 1984), 1359 adults travelling in 858 vehicles were observed. Almost all cars have safety belts in the front seat, while it is estimated that 40% of the cars have belts in the rear. About 60% of drivers had access to inertia-reel belts whereas the remainder had access only to static belts. Overall, 79% of drivers were judged to be wearing a safety belt properly, while 12% were wearing a poorly-adjusted belt. Therefore, 91% of the drivers could be considered to be belted. About 60% of front-seat passengers had access to inertia-reel belts. Front-seat passengers were properly belted in 77% of the cases, while another 13% were wearing the belt too loosely. Overall, the front passenger belt use rate of 90% did not differ from that of drivers. On the other hand, only 42% of rear-seat passengers had access to any kind of safety belt system. From a small number of observations (N=51), only 14% of rear-seat passengers were properly belted, while an additional 4% were improperly belted.

UNITED KINGDOM

A summary of UK national surveys of safety belt use is provided by Dale (1985). A series of fifteen surveys was undertaken between October 1972 and September 1980, essentially to monitor the effects of public education campaigns on belt use. Samples of cars and vans were stopped by police, and the safety belt use of their occupants was observed during the course of a short interview. The sample of sites is known to have been weighted towards major roads, leading to an over-estimate of true national use rates by about 3%. Safety belt use was 20% among drivers in the first of these surveys, rising to 33% by the middle of the period, and remaining thereafter at 30-33%.

The introduction of the mandatory safety belt use law brought a new series of national surveys, apparently more frequent and representative than those conducted nationally in any of the other OECD countries. Surveys were undertaken at 55 sites, randomly selected from the UK's 180 sites used for monthly traffic volume estimation. Surveyed vehicles therefore represented traffic with known probabilities, and the observations could be grossed up to national traffic estimates. Surveys were repeated monthly during the year prior to the legislation's effective date of January 31, 1983, and for each of the subsequent 15 months, after which they were continued bi-monthly. To August 1985, a total of 35 national surveys had therefore been undertaken during the previous 3 1/2 years. Observation of occupants of moving cars and vans were made by observers concealed in parked cars or workmen's huts. Observations were made for the period 0830-2150 hours, though at 29 of the 55 sites observations after dark were not possible as the sites were unlit.

The surveys showed that front seat occupant belt use rates had reached over 50% by the month before the law became effective. They then rose to about 93% immediately after the law, and settled within a further two months to about 95%, which was sustained until the last reported survey in August, 1985.

UNITED STATES OF AMERICA

Two national observational surveys of occupant restraint use were conducted in the United States during 1982 and 1983 (Perkins, Cynecki and Goryl, 1984; Phillips, 1983). Since the methodology for these surveys was essentially the same, the most recent one will be described. Between November, 1982 and December, 1983 a team of observers travelled to 19 cities, representing all regions of the United States. Within each city, 30 sites were selected randomly using a grid system, in order to represent major arterial and freeway exit traffic in a 7:3 ratio. In addition, three sites located at shopping malls were selected in order to observe passengers' use of occupant restraints. The driver observations were conducted Monday to Thursday, while the passenger observations were performed Friday to Sunday. Driver belt use was observed between 0700 and 1900 hours, but the observation of passenger use was restricted to the time period that the shopping mall was open for business. Each city was surveyed once per quarter (i.e. every three months).

The sampling population was restricted to private passenger cars and station wagons. For the driver survey, vehicles stopped at traffic lights or stop signs were observed. At those intersections controlled by traffic lights, if more than one vehicle stopped, the second vehicle was observed first, followed by the third and so on. At intersections controlled by stop signs, all vehicles stopping were included. In the passenger survey, the primary targets were vehicles containing children, but if no vehicles with children were available, adult passengers were observed. The observers were stationed at the exits of shopping malls, where they observed the target vehicles stopped at a traffic light or stop sign.

The results of the 1983 survey revealed that 14% of 146,305 observed drivers were wearing a safety belt, up slightly from the 1982 figure of 11.3%. Belt use among drivers was clearly highest among those in the West (21.1%) and lowest in the South-East (10.0%). Driver belt use did not vary by time of year. Belt use was higher among drivers of cars manufactured since 1980 and among those driving smaller cars, particularly "subcompacts" (19.8%). Not surprisingly, drivers in vehicles equipped with automatic safety belts were much more likely to be belted (82.7%), although the sample size was small. Belt use was highest among drivers of imported cars (23.4% vs. 11.3%). Driver safety belt use was also slightly higher during the time period 0700-1000, during the week, at freeway exits, and when it was raining.

A total of 73,646 adults were observed in the passenger survey, of which 10.5% were belted. Belt use varied by seating position, being highest in the right front seat and lowest in the middle positions in both the front and the back seats. While it appears that passenger belt use is lower than that of drivers, the two percentages are not directly comparable because they are based on observations made at different locations and at different times.

In 1981, a national telephone survey was conducted with licensed drivers 18 years of age or older (Mayas, Boyd, Collins and Harris, 1983). The respondents were selected employing a random-digit-dialling sampling procedure, stratified by region and by Metropolitan/non-Metropolitan status. Of the 1228 drivers interviewed, 24% said they always wore a safety belt when driving on wet or snow/ice covered roads. More drivers said they always wore belts on long trips (27%) than on short trips around town (16%). Belt use was reported to be more frequent when respondents were driving (19%) compared to when they were travelling as passengers (12%). Combining the responses to the questions concerning use of safety belts in a variety of conditions, it was estimated that 29% of the respondents were "frequent users", 30% were "sometimes users" and 41% were "infrequent users".

Starting in 1982, monthly telephone interviews concerning safety belt use have been performed with a nationally representative sample of about 1000 drivers. The most recent survey results indicated that 33.2% of drivers report always wearing belts when driving on wet or icy roads, 38.4% always wear them on long trips and 25.3% always wear them on short trips. Overall, 22.8% of the drivers said they always wore safety belts and 26.6% said they never wore them (McGinley Market Research, 1984).

The Fatal Accident Reporting System (FARS) is operated by the National Highway Traffic Safety Administration (NHTSA) to provide detailed information concerning traffic accidents that result in a fatality. The data are collected at the state level by accessing a variety of sources (eg. police accident reports, driver licensing files, coroner reports) and entered into NHTSA's computerized central data file. Among the 26,073 fatally-injured drivers in 1982 where belt use was known, 4.3% were reported to be wearing a safety belt. This compares to 3.6% for fatally-injured passengers.

NHTSA also operates the National Accident Sampling System, which is designed to provide basic information through investigations of a representative sample of police-reported accidents. Fifty teams operate throughout the country collecting data from the accident scene, the vehicles involved in the accident and the drivers involved, as well as from police reports, hospital records and coroner's files. Overall, 12% of the more than 12 million vehicle occupants studied in 1982 were restrained. Restraint use was found to decrease as injury severity increased. Belt use was highest during the daytime on weekdays (13.5%) and lowest on weekend days (10.5%). Occupant belt use was somewhat higher for those travelling in smaller cars (13%) than for those travelling in light trucks (7%).

In addition to the above national surveys, a number of state or local surveys have recently been conducted, to evaluate various new belt-use laws. Among the most substantial state-wide surveys have been those in the three states reviewed below.

1. MICHIGAN

A series of belt use surveys is being undertaken in Michigan to evaluate the effects of the State's mandatory belt use law, which became effective on July 1, 1985. Two pre-legislation surveys and one post-legislation survey have been reported upon (Wagenaar and Wiviott, 1985 and 1986; Wagenaar, Wiviott and Compton, 1985).

Probability samples of vehicles and vehicle occupants were designed to be obtained through a multi-stage, stratified sampling process. To allow observation of restraint use by all occupants of light vehicles, it was first decided that the survey locations would need traffic signals so that observations could be made with vehicles stopped. To obtain samples of signalized intersections, for seven regional strata, primary sampling units (PSU's) of counties having more than three such intersections were drawn, essentially with probability proportional to population. Within PSU's intersections were selected with known probability from lists of eligible intersections, and at rates of one freeway exit location and three other locations per PSU. A total of 240 sample sites was selected. Then survey times were selected to represent all days of the week and all daylight hours, during the three-week period of each survey. At each site, observers selected vehicles by taking up to three in order as they stopped at traffic lights. Restraint availability and use was recorded for six primary seating positions, plus the other possible locations of passengers in vans and station wagons.

The survey of December, 1984 observed 17,568 occupants in 11,906 vehicles. The final weighted estimates of safety belt use were 19.5% for drivers and 19.8% for all occupants. The next pre-legislation survey in April, 1985 observed 18,581 occupants in 12,345 vehicles, and found 26.0% of drivers and 25.8% of all occupants to be using belts. Then the first post-legislation survey, in July 1985, obtained observations on 20,023 occupants of 12,263 vehicles, and found use had increased to 61.3% among drivers and 58.4% among all occupants.

2. NEW JERSEY

Safety belt use legislation took effect on March 1, 1985, and has been evaluated using surveys of belt use in February and July of 1985 (Brick, Edmonds and Lago, 1985). A stratified multi-stage probability sample was designed to represent front-seat occupant travel. In the first stage of sampling, counties were grouped into two strata on the basis of population density, and four counties were selected in each stratum with probability proportional to size. Then a total of 42 census tracts were selected from the chosen counties with known probability. Three classes of road were defined by traffic volume, those in the highest volume class being listed for each selected county, and those in the lower volume classes being listed for each tract. Random selections were then made of road segments within each of the three defined classes, then of an intersection on each selected road segment. Survey time period, traffic direction and lane were also randomly assigned for each site.

Observers were allowed to determine whether the intersection or a mid-section point of the road was their best viewpoint, and observed traffic moving or stopped accordingly. The availability and use of safety belts was recorded for drivers and front-seat passengers, together with site information.

Surveying was completed in 630 survey stints of 40 minutes each, covering the hours 0800-1700 and all days of the week. Totals of 97,000 front-seat occupants were observed in February 1985, and 121,000 in July 1985. The estimated state-wide use of belts by front-seat occupants increased from 18.2% in February (with 95% confidence interval of 15.3%-21.1%) to 40.0% in July (with 95% confidence interval of 33.9%-46.1%).

3. NEW YORK

The introduction of seat belt use legislation at the end of December, 1984 was evaluated using state-wide surveys of use in October, 1984 and April, 1985 (Rood, Kraichy and Carubia, 1985). Probability samples were designed, selecting road sections stratified by country population density and by volume of traffic, and with random selection of survey time, traffic direction and lane. Surveying was done in one-hour stints at each selected location between 8am and 5pm, on all days of a four-week period for each survey. Observations were made with vehicles stopped at traffic signals or stop signs if such controls existed in the selected road segments, or otherwise with vehicles moving. Observers recorded use and availability of belts by front-seat occupants.

In addition, similar observations were made in darkness (1900-2130) at a subsample of sites, judged well-lit and safe.

The surveys were on a relatively large scale: the April survey, for example, included 1300 hours of observation at 700 sites, and recorded 243,701 observations of occupants.

The surveys found that belt use statewide increased from 16% in October to 57% in April. Regionally the increases were from 19% to 60% "upstate", from 14% to 56% in New York City, and from 17% to 58% in Long Island. After the law, belt use was marginally higher on weekends than weekdays, and in rush hours rather than at other hours. The subsidiary survey showed use in darkness only very slightly lower than in daytime: 50% compared to 52%, on the subsample of sites. The survey was large enough to allow slight differences in patterns of use by time and region to be confidently recognized.

SAFETY BELT USER CHARACTERISTICS

In this section, the characteristics of users and non-users of safety belts are summarized according to the following categories: demographic, internal states (ie. perceptions, attitudes, motivations, personality), other driver and health related behaviors, and driving record (ie. accidents and violations).

DEMOGRAPHIC

Sex

The most consistent finding in the literature with respect to user characteristics is that female vehicle occupants are more likely to be observed to be wearing a safety belt than male occupants (Arora, 1982, 1985; Bergan et al., 1979; Boughton et al., 1980; Bylok et al., 1983; Evans and Wasielewski, 1983; Hearne, 1980; Manders, 1984; Murray, 1984; New Brunswick Department of Transportation, 1984; Perkins et al., 1984; Phillips, 1983; Wagenaar et al., 1985). Several studies have found that females are also more likely to report using seat belts than are males (Jonah and Dawson, 1982; Wessex Positive Health Team, 1980; Wilson, 1984). A few observational studies failed to find such a relationship. Matthews (1984) found male drivers in Ontario, Canada, to be using belts more often, as did Schnerring (1983) in New South Wales, Australia. Appleton (1983) found in New Zealand that while women are more likely to use safety belts when driving than men, they are also more likely to wear them improperly (ie. too loose).

While, on balance, women are more likely to use seat belts than are men, the differences are not normally very large. Sex does not explain much of the variance in use from location to location or over time.

Age

The relationship between belt use and age appears to be more complicated than that for sex and belt use. In jurisdictions without safety belt use laws, observed use seems to be related to age in a curvilinear fashion for both sexes such that occupants in the youngest and oldest age groups have the lowest use rate (Dale, 1985; Evans and Wasielewski, 1983; Perkins et al., 1984; Waskielewski, 1984; Wessex Positive Health Team, 1980). A similar relationship has been noted in a telephone survey conducted with drivers in the United States, in which reported belt use was highest in the age group 23 to 34 (Mayas et al., 1983). On the other hand, in jurisdictions with safety belt use laws, the use of belts has generally been found to increase linearly with age for both sexes (Arora and Lawson, 1982; Bylok et al., 1983; Manders, 1984; Murray, 1984; Torrington and Hull, 1980; Wilson, 1985). Exceptions to this rule were found in studying several Australian cities, all of which were subject to seat belt use laws, and in which no relationship between age and belt use was noted (Boughton et al. 1980).

Canada has been unusual in having extended experience with belt use laws in some provinces and not in others. Examining the relationship between age and belt use separately for legislated and unlegislated jurisdictions, it has been found that belt use increases with age in the former case but decreases with age in the latter, (Arora, 1984, 1985). Jonah (1984) found that reported driver belt use increased as a function of age in provinces with safety belt laws, but showed no relationship in provinces without such laws. Examination of changes in the relationship between age and belt use as a function of the introduction of a safety belt law in Saskatchewan revealed that before the law, belt use decreased with age but after the law, it increased with age. Comparison of the 1981 and 1982 usage figures for Newfoundland (Arora, 1982, 1984) indicates that prior to the belt law, there was no clear relationship between age and use but after the law went into effect, belt use generally increased with age. A similar comparison of the 1983 and 1984 surveys for Manitoba (Arora, 1984; 1985) showed that prior to belt use legislation belt use generally decreased with age but after the introduction it increased with age.

These results on the relationship between age and belt use suggest that before safety belt use becomes compulsory, its major determinants may be education and the beliefs about safety belts. Since the younger generations have on average a greater level of education than those before them, they may be more knowledgeable about and hence more favorably disposed to wearing seat belts. The youngest age group (16-24) might be an exception to this tendency, having less social education than does the 25 to 40 age group. This could account for the curvilinearity in some of the studies whereby the middle age groups have the highest usage. Another important factor may be that younger drivers know the advantages of safety belts but prefer to take the risk rather than appear too cautious to their friends. In contrast, the oldest drivers might not really appreciate the value of safety belts since for most of their lives, vehicles were not equipped with them. Hence, the middle age group having greater knowledge of the value of belts and less concern about appearing too cautious among their peers, are more likely to wear their belts in unlegislated jurisdictions.

When the use of safety belts becomes compulsory, the motivation underlying belt use may change such that older drivers are more concerned about being apprehended and fined for non-use of belts than are younger drivers. Moreover, younger drivers may have less respect for traffic laws in general than older drivers and hence fail to use safety belts as a display of bravado. Consequently, belt use increases linearly with age.

Socio-economic status

Research on the relationship between socio-economic status (SES) variables and safety belt use is sparse. In a Canadian study (Bragg, 1973), belt use increased as a function of occupational status. In a study conducted in Birmingham, England during 1971 by the University of Aston (1972), about 250 respondents were interviewed concerning their use of safety belts and other issues including social class. It was found that belt use was highest among the unskilled and semi-skilled respondents and among the professional and intermediate classes but lowest among the skilled respondents. Phaner and Hane (1973), having reviewed the available literature at that time concluded that belt use increased with SES. Phaner and Hane also concluded that education level was strongly related to belt use such, that as education increases, so does belt use. More recently, Bergan et al. (1979) have reported that observed belt use in Saskatchewan increased from about 10% among those drivers with elementary school education to 51% among those with some university education. Similarly, in a national survey, Jonah and Dawson (1982) discovered that the frequency of reported belt use (ie. number of times belt worn on last ten trips) increased with level of education, those having some university education reporting using safety belts 71% of the time, while those who had not completed high school wore belts only about half of the time. There was also a relationship between income and belt use such that respondents with higher incomes were more likely to wear seat belts. Jonah (1984) examined the same survey data separately for legislated and unlegislated provinces and noted that education was a stronger predictor of past and intended belt use among those respondents residing in unlegislated provinces.

About 1000 American drivers interviewed by telephone were more likely to report use of safety belts if they had at least some college education although the results were not clearly linear due most likely to small sample sizes for some of the education classifications (Mayas et al., 1983). Pederson and Mahon (1983) found from their interviews with drivers in the Australian Capital Territory that belt use increased with occupational class and income, with some residual increase still due to education. Finally, Wilson (1985) recently found that self-reported safety belt use during the past ten trips was significantly correlated with education level (r=.23).

While the above studies clearly substantiate a positive relationship between education and safety belt use, the nature of this relationship is unclear. On the one hand, it might mean that the level of knowledge regarding the effectiveness of safety belt use for reducing casualties increases with education. On the other, it may reflect differences in attitudes regarding belt use or in values concerning risk-taking in general. Another possibility is the fact that education is related to income. The higher one's income, the more likely one can afford a new car and new cars will on average have better designed safety belts which are more likely to be used (Bragg, 1973).

Marital status

Marital status is related to safety belt use such that married people are typically more likely to report using belts than single people (Bergan et al., 1979; Jonah and Dawson, 1982; University of Aston, 1972; Wilson, 1985). However, this relationship may actually reflect an underlying age difference, since single people are more likely to be younger.

In summary, belt use appears to be more frequent, among women, older vehicle occupants (particularly in legislated jurisdictions), those with higher levels of SES and education, and those that are married.

INTERNAL STATES

In this section, the relationships between belt use and internal states such as perceptions, attitudes, motivations and personality are considered.

Perceived accident risk

Bragg (1973) found a significant curvilinear relationship between the perceived likelihood of involvement in a personal injury accident and reported safety belt use, such that those persons who think there is a high likelihood and those people who think there is a low likelihood are most likely to use belts, whereas those who perceive a moderate risk of an injury are less likely to wear them. Bragg and Finn (1982) had younger and old drivers negotiate their vehicles over a prescribed route in Boston with and without wearing a belt. Interestingly, drivers perceived more risk of an accident when they were belted than when they were unbelted. Although order effects were not controlled, the authors concluded that putting on a safety belt may have sensitized the driver toward the risk around him. Mayas et al. (1983) report that frequent and infrequent belt users perceived greater risk of others crashing into them than did "sometimes" users. Jonah (1984) showed that concern about automobile safety was a better predictor of past and intended belt use in jurisdictions with safety belt use laws than it was in unlegislated jurisdictions. In general, it appears that the relationship between the perceived risk of accident involvement and reported belt use is a rather complex one, to say the least.

Perceived enforcement

In a study conducted in Ontario, no relation was observed between self-reported belt use and either the perceived number of drivers charged for not wearing a safety belt in the community, or the perceived likelihood of being apprehended by the police for non-use of belts (Jonah and Dawson, 1982b). Using a different measure of perceived risk of detection (time before a non-user gets caught), Bylok et al. (1983) reported that non-users perceived it would take longer to be apprehended for non-use than did users. Bergan et al. found no relationship between whether or not a driver had received a fine for the non-use of safety belts and current use of belts. Jonah, Dawson and Smith (1982) have proposed that the effect on belt use of Selective Traffic Enforcement Programs (which consist of police enforcement, publicity concerning the enforcement and public education) is mediated primarily through the subjective probability of apprehension for not wearing a belt.

Attitudes

Several studies examined the relationship between beliefs and attitudes concerning safety belt use and reported belt use. In an early study by Fhaner and Hane (1974), a correlation of .56 was found the respondent's attitude toward belt use and reported belt use. In addition, the more respondents believed safety belts were convenient and comfortable to use, and effective in reducing the likelihood of an injury being sustained in an accident, the more positive their attitude toward belt use was, and the more likely they were to report wearing belts. In combination, the beliefs about effectiveness, comfort and convenience accounted for about 65% of the variance in the attitude toward belt use and about 30% of the variance in reported belt use. In a second study by Fhaner and Hane, observed usage was correlated .38 with the weighted sum of the discomfort and effectiveness beliefs factors. Inclusion of other factors did not improve the prediction, suggesting that the major beliefs underlying belt use are related to perceived effectiveness and comfort.

Jonah and Dawson (1982b) have shown that not only does the attitude toward safety belt use *per se* predict reported belt use, but so does one's favorability toward belt use laws. Together these two attitudes accounted for 44% of the variance in reported belt use. This result has been substantiated recently by Jonah (1984) for both jurisdictions with and without belt use laws.

Ashton and Warr (1976) hypothesized that the relationship between attitudes toward belt use and actual and reported belt use would be moderated by the person's level of anxiety about being involved in a traffic accident. Drivers entering a parking lot were asked to complete a questionnaire, belt users being given one version while non-users were given a slightly different version to permit the identification of user/non-user groups. As predicted, the correlations between actual and reported belt use and the opinions about comfort and effectiveness, as well as the general evaluation of safety belts were greatest for subjects with the highest level of anxiety about accident involvement. About three times as much variance in reported belt use was accounted for by the attitude toward belt use in the high anxiety group (45%) than in the low anxiety group (14%). Similarly, four times as much variance in actual belt use was accounted for by the attitude toward belt use in the high anxiety group (32%) than in the low anxiety group (8%). Bragg (1973) had noted a similar moderating effect of concern about accident involvement in an earlier study, although the effect was not as pronounced. These results suggest that attitudes toward belt use become more important in predicting belt use when one is concerned about being injured in a traffic accident.

Pressure from friends, family

The distinction between attitude and motivation is not an easy one to make. While attitudes reflect the propensity to behave in a particular fashion, motivations perhaps reflect the forces underlying these propensities. A number of researchers have noted that the presence of a passenger tends to be related to belt use by the driver (Ashton et al., 1983; Boughton et al., 1980; Hearne, 1980; Mackay, 1982; Schnerring, 1983). Moreover, there is evidence from these studies that if the front-seat passenger is belted, the driver is more likely to be belted and *vice versa*. While one might argue that people with similar habits and attitudes toward belt use are more likely to travel together, it is conceivable that belted occupants can facilitate belt use by other occupants either directly (i.e. requesting others to put on belts) or indirectly (i.e. serving as a model). Mayas et al. (1983) showed that frequent belt users were more likely to be wearing a belt than infrequent belt users when they asked others to buckle up. Furthermore, 96% of these requests to buckle up were apparently obeyed. However, only 55% of drivers made the request to others, and these were primarily frequent or "sometimes" users of belts.

Jonah and Dawson (1982b) and Jonah (1984) examined the role of normative pressure from friends and family in influencing belt use by drivers. In the first study, subjects were asked their agreement with the statements: "My friends and family believe that I should always wear a seat belt when I am driving". After controlling the variance accounted for by attitude toward belt use laws and belt use per se, the normative pressure variable still accounted for a significant amount of variance. In the later study, the normative pressure from friends and family were measured separately. Normative pressure accounted for about 6% of the variance in intended belt use after the attitude toward belt use was controlled for, and about 3% of the variance in past belt use. These studies clearly demonstrate that pressure from friends and family members does motivate some people to wear safety belts.

Reasons for non-use

A number of studies have investigated the reasons that people do and do not wear safety belts. A British survey identified the major reasons for non-use to be the restriction of movement, discomfort and laziness or forgetfulness (Wessex Positive Health Team). Knapper and Cropley (1976) reported that the major predictor of reported belt use in urban areas of Saskatchewan, as well as on the highway, was the level of agreement with the statement, "When I get into the car, I never think of putting a seat belt on". Knapper and Cropley concluded that the major determinant of belt use was "not a matter of positive or negative evaluation at all but depended upon whether respondents had got into the habit of using seat belts" (p. 245). Jonah and Dawson (1982a) noting very positive attitudes toward belt use but only a reported use rate of 60% similarly concluded that "while Canadians believe that they should wear seat belts, they have as yet not developed the habit of seat belt use" (p. 55). In an Ontario survey of drivers (Bylok et al., 1983), the major reasons given for wearing a safety belt by those observed to be wearing them were safety (50%) and because it is the law (36%). Among the observed non-users, the major reasons for non-use were forgetfulness, inconvenience, and the belief that it was unnecessary, all of which were given equally as often. Mayas et al. discovered that infrequent users in the United States expressed greater fear of being trapped by a safety belt following an accident than did more frequent users, suggesting that some of the myths about belt use may still be influencing belt use.

Personality

The final set of internal state variables is personality. Clement and Jonah (1984), Jonah (1984), Mayas et al., (1983) and Wilson (1985) have all failed to show any relationship between Rotter's (1966) measure of internal/external focus of control and reported safety belt use. Clement and Jonah detected a weak correlation (r=-.15) between Zuckerman's (1975) sensation-seeking measure and reported belt use among women, but not among men. Wilson found a similarly weak relationship (r=-.13) between these variables among a sample of tavern patrons and convicted impaired drivers, such that non-users tended to be sensation-seekers. In addition, reported belt use was weakly related (r=-.14) to driving aggression (Parry, 1968) and assaultiveness, r=-.14 (Jackson, 1980). Reported belt use was also related to social desirability (r=-.16), such that the more respondents asserted good things about themselves, the *less* likely they were to report belt use. No significant relationships were observed by Wilson between seat belt use and attitudes toward competitive speed, inhibition during driving, driving to reduce tension, resentment, verbal hostility, depression, alienation, impulse expression, self-depreciation, or social exhibition.

OTHER DRIVING AND HEALTH RELATED BEHAVIORS

Seat belt use has been related to a variety of other driving and health related behaviors.

Alcohol use

In night-time roadside surveys of alcohol impaired driving in Canada, legally-impaired drivers (i.e. blood alcohol concentration over 80 mg%) have been observed to be less likely to be wearing a safety belt (Lawson et al., 1982, Ontario Interministerial Committee on Drinking Drivers, 1980). This relationship may exist because drivers, being in a state of impairment, forget to put on their safety belt; or alternatively, the two behaviors may not be functionally related but be two aspects of risk-taking or risk-tolerance. That the latter interpretation is more likely is supported by research by Wilson and Jonah (1985) and Wilson (1985), in which survey respondents who indicate that they have driven while legally impaired by alcohol during the past month are less likely to report the use of safety belts.

Driving behavior

No relationship between the observed use of belts and measured speed has been reported in the literature (Geller, 1982; Mackay, Dale and White, 1982; Wasielewski, 1984; Wilde, 1977). However, in a survey by Wilson (1985), belt non-users said they would travel faster on an uncrowded highway than would belt users (r=-.14). Arora (1984) reported that safety belt wearers are more likely to turn their headlights on during the daytime than non-wearers, thereby increasing their conspicuity. Jonah, Arora and White (1985) and Stulginskas and Pless (1983) have found that drivers who use their belts are also more likely to ensure that the children travelling with them are adequately protected by occupant restraints.

Several studies have shown that the belt non-users are more apt to place themselves in situations where a conflict with other drivers is likely. Ashton et al. (1983) measured gap acceptance, safety belt use and several other variables at three intersections in Britain. Belted drivers waited for longer gaps in the traffic before turning in front of it than did unbelted drivers. Evans and Wasielewski (1983) and Evans et al. (1982) have observed that unbelted drivers are more likely than belted drivers to "tailgate" vehicles in front of them (i.e. drive with shorter headways), thereby leaving less time for evasive action. Deutsch et al. (1980) recorded the belt use of drivers jumping red traffic lights and discovered that they were more likely to be non-users of belts than those who did not jump the light. These studies support the claim that the non-users of safety belts are more likely to take risks while driving than are belt users.

Other behavior

With respect to health-related behaviors, Mayas et al. noted that frequent users of belts were more likely than infrequent users to report taking precautions concerning their personal health such as not smoking, visiting the dentist regularly, and engaging in regular exercise. Moreover, belt users were more likely to agree that belt use is like other good health practices. In a survey conducted in south-west England, non-smokers were almost twice (66% vs. 38%) as likely to report using safety belts than were smokers (Wessex Positive Health Team, 1980). However, Wilson (1985) found only a marginally significant relationship between smoking and belt use (r=-.11). Wilson noted that the non-users of safety belts consumed more alcohol during the past 7 days (r=-.21), drank greater amounts of alcohol per drinking occasion (r=-.26), had got drunk at an earlier age (r=-.22), and were more likely to use marijuana (r=-.25) or other illicit drugs (r=-.30).

As a whole, these studies concerning other driving and health related behaviors strongly suggest that the non-use of safety belts is part of a syndrome of a high risk behaviors. Therefore, the non-use of belts may be indicative of a lifestyle characterized by risk.

Driver record

Evans and Wasielewski (1982) and more recently Wasielewski (1984) have photographed drivers and their vehicle's license plate numbers as they were travelling along highways in Michigan, an unlegislated jurisdiction. Using the license plate number and the driver's sex and approximate age, Wasielewski was able to locate the drivers' records. Drivers with one or more accidents on their driving record were less likely to have been observed wearing a safety belt, although the correlation was weak (r=-.05). Non-users of belts were also more likely to have demerit points on their record than were belt users (r=-.11). Similar results were reported by Evans and Wasielewski (1982).

Grant (1986) has examined the relationship between observed safety belt use and driver records for a sample drivers from Ontario, where belt use has been compulsory since 1976. Driver safety belt use was observed at the roadside, as were driver age and sex, and the vehicle license number. The license number and the observed driver characteristics were used to match drivers records. Overall, non-users were more likely to have committed traffic violations (r=-.11) and have been involved in traffic accidents (r=-.06) than were belted drivers.

Finally, self-reported non-users of safety belts report greater involvement in traffic accidents than do belt users (r=-.27; Wilson, 1985). Indeed, non-users are more likely to admit that they have been responsible for the accident (r=-.17). Finally, non-users were only slightly more likely than users to report traffic violations (r=-.11).

In summary, these data suggest that the drivers who fail to wear safety belts are the same ones who are being involved in traffic accidents. This involvement in accidents appears to result from the propensity for these drivers to engage disproportionately in risk-taking while driving. Their risk-taking seems to stem more from their belief structure and its underlying motivational base rather than from a failure to perceive risk in the traffic environment. Safety belt non-use may be tightly embedded in a lifestyle characterized by a general disregard for safety. Therefore, at least for some non-users, it may be necessary to change their whole lifestyle before one can expect them to start using safety belts.

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CASUALTY REDUCTIONS RESULTING FROM SAFETY BELT USE LAWS

James Hedlund

1. INTRODUCTION

Since 1970, mandatory safety belt use laws have been implemented in more than 30 countries. These laws sought to raise belt usage substantially from the levels observed without a law. A usage increase in turn should reduce occupant casualties. Data assembled for this project show that mandatory use laws increase belt usage from 30 to 65 percentage points (see the working paper on belt use for a thorough discussion). The evidence on casualty reduction, though, is far less clear. This working paper considers available data and studies supplied by OECD countries in an attempt to understand the casualty reductions attributable to belt use laws.

The paper's remaining sections are:
2. Overview.
3. Belt effectiveness in a crash.
4. Casualty reductions expected from a belt use increase.
5. Results from different countries.
6. Discussion.
7. Recommendations.

2. OVERVIEW

In examining casualty changes resulting from belt use laws we must be careful to distinguish the benefits of a belt system to an individual occupant from the benefits of a belt usage change in the population as a whole. Belt system benefits measure the protection afforded to an individual in a crash. This is usually expressed as the percent reduction in injuries of a given level -- for example, a study may find that belted occupants are 50% less likely to be killed than unbelted occupants. We follow the usual practice and call this the system's "effectiveness". Continuing the example, the study would report that belts are 50% effective in reducing fatalities.

Belt effectiveness, though expressed in individual terms, is of course an average measure. It measures the average injury probability difference between belted and unbelted occupants, across the whole range of crashes, for all occupants in a given population (such as passenger car occupants). It assumes that belts are worn properly. In a sense it measures the potential benefits available from a belt system. Section 3 discusses belt effectiveness in more detail.

The benefits resulting from a belt usage change depend on belt effectiveness but are more difficult to understand and measure. Clearly, if belts reduce an individual's chance of injury or fatality, then a belt usage increase should decrease total casualties. But a belt usage increase need not reduce casualties proportionately. There are several reasons. The mathematical relationship between belt effectiveness, usage increase, and casualty reduction is not a direct proportion. Belt usage data from the driving population may not reflect usage in the accident-involved population. Belts may be misused, thus reducing their effectiveness. Belt effectiveness estimates may be based on a different accident population or a different injury threshold from that used to measure casualty changes.

To emphasize that casualty changes following a belt law are not the same as belt effectiveness, we shall use "belt law performance" to describe these casualty changes. A more thorough discussion of belt law performance and the way in which we measure it is given in Section 4.

Section 5 discusses results from each country. We use the reported usage and casualty changes to derive belt law performance in a standard form, so that results from different countries can be compared. Some countries have substantial data both before and after their belt use laws, have attempted to reassure other factors affecting casualties during this period, and have analyzed their data in detail. Other countries have limited data, no consideration of other factors, or no analysis. We present each country's belt law performance results, realizing that some are much more substantiated than others.

Section 6 examines the assembled data from all countries. The evidence is varied, but the patterns that emerge suggest that belt law performance improves as usage increases -- that belt usage laws achieve more and more of the ideal benefits promised by belt effectiveness as usage approaches 100%. These observations suggest the recommendations of Section 7: that countries strive to increase belt usage in order to gain increasingly greater benefits, and that more data and better analyses are necessary to understand belt law performance more precisely.

3. BELT EFFECTIVENESS IN A CRASH

There is virtually unanimous agreement that belts are effective in a crash: on the average, a belted occupant will fare better in a crash than an unbelted occupant. There are literally hundreds of studies addressing this issue (see (Walz et al, 1977) or (Ruter, 1978) for extensive references). There is the occasional crash where belts are harmful instead of helpful, but these are so rare as to be completely dominated by crashes where belts produce substantial benefits. The issue is then to quantify these benefits.

Belt effectiveness studies are of three principal types.

1. Clinical: analyze individual crashes to estimate the injuries a belted occupant would have received if he had been unbelted, or the injuries an unbelted occupant would have received if he had been belted.

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This examination of well-documented crashes by crash reconstruction experts gives a good understanding of safety belt benefits in specific crash situations. However, as the method is limited to individual crashes, it does not yield any overall belt effectiveness estimate. In addition, since belt benefits are determined by judgment, it is somewhat subjective.

2. Matched comparisons: select a group of crashes, similar in important variables that affect injury (such as vehicle impact point and damage, occupant seating position and age, and so forth), and compare injuries to belted and unbelted occupants. This method lessens subjectivity, as actual injuries are compared rather than hypothetical ones, but does not eliminate it, as the choice of similar crashes is generally subjective. Again, the method does not yield directly an overall belt effectiveness estimate.

3. Statistical: compare the injury distributions of belted and unbelted occupants in a large crash population. A large data set is required, so that injury quantification is usually quite coarse: AIS codes, or police injury codes, or perhaps even "fatal, injured, uninjured". More important, the analysis must control for other factors that influence injury, to assure that any injury differences observed are due to belts. Especially absent a belt law, an average belted driver has been shown to be involved in fewer crashes, and fewer severe crashes, than an unbelted driver. Some crash severity measure not involving injury is required to control for this.

For use in estimating belt law performance, the best studies are statistical: we need to know the expected casualty reductions across all crashes for belted compared to unbelted occupants. But, to be useful, the studies must be based on sufficient observations to yield accurate results and must control for other injury-producing factors.

There is no single best study. Effectiveness studies agree that belts are highly effective in preventing serious or fatal injury given a crash. Our summary effectiveness estimate is 40-50% -- that is, a belted occupant is 40- 50% less likely to be seriously injured or killed than an unbelted occupant, measured across the whole range of crashes that can produce serious injury or fatality. Some studies claim considerably higher effectiveness and few claim lower. The 40-50% estimate discounts the higher claims somewhat on two grounds. First, clinical studies may focus on crashes where belts offer substantial benefits, and so may overstate belt effectiveness over the whole range of crashes. Second, few statistical studies control adequately for other injury-producing factors, and the effect of insufficient control is to bias the results in favor of higher belt effectiveness.

4. CASUALTY REDUCTIONS EXPECTED FROM A BELT USE INCREASE

To measure belt law performance we start with a very simple relationship of casualties, belt usage, and belt effectiveness.

Define: u = belt usage
u1 = before a law
u2 = after a law

c = Casualties
  c1 = before a law
  c2 = after a law

Dc = proportionate casualty reduction = 1 - c2/c1

e = belt effectiveness = 1 - rb/rn
  where rb = injury rate if belted
  rn = injury rate if not belted

If usage changes from u1 to u2, if belt effectiveness remains at e, and if all other factors remain constant, then

$$Dc = \frac{e\,(u2 - u1)}{1 - e\,u1} \tag{1}$$

Here, casualties and usage refer to the same population. If usage is measured for passenger car drivers only, then the casualty change also refers to passenger car drivers.

As an example, suppose a belt use law applies to front seat passenger car occupants, that usage rises from 20% to 60%, and that belt effectiveness is 45%. Then Dc = .198, or about 20%: front seat passenger car occupant casualties should fall by about 20% after the law.

This simplistic analysis requires many strong assumptions. There is no trend: all other factors affecting traffic casualties remain constant. The usage data apply to those in potentially casualty-producing accidents. Belt effectiveness is known. And, of course, casualties are measured accurately and consistently. These assumptions usually are not satisfied.

Trend

Other factors affecting traffic casualties are rarely constant. Sometimes the influences are explicit, as when a speed limit change occurs close to a belt use law. Sometimes they are not, as when the long-term casualty trend is up or down. There are always 'random' or inexplicable casualty fluctuations, especially in the short run with rare events such as fatalities. As a result, uncontrolled before-after comparisons may be misleading.

If a single trend factor t can be estimated, then (1) may be modified.

$$Dc \quad \frac{(1 - t) + e\,(t\,u2 - u1)}{1 - e\,u1} \tag{2}$$

Here, t measures the estimated trend in casualties after the law compared to before the law if there had been no law. So t = 1 assumes no change (in which case (1) and (2) agree), t 1 means that casualties would have dropped even without a law, and t / 1 means that casualties would have increased without a law.

The trend factor t may be estimated in various ways.

o Cross-section data: estimate t for a given country by the casualty change in other countries not affected by the law. If a law applies only to a province or state, estimate t from adjacent or similar provinces or states without law changes. This method assumes that other factors affecting the countries or jurisdictions are the same.

o Different road user data: estimate t for a country by the casualty change of road users not affected by the law. For example, if a law affects only passenger vehicle occupants, estimate t from truck, motorcycle, pedestrian, and bicyclist casualties. Besides assuming that casualty trends are the same for the two groups, this method also assumes that the law has no indirect effects -- for example, that there is no risk compensation.

o Time series data: use a time series method, such as Box-Jenkins, to disaggregate the effects of trend and other interventions from the effects of the law change. These methods provide a better analytic framework at the price of increased complexity and increased data requirements. They are still subjective and still require assumptions, though the subjectivity and assumptions are hidden behind the apparent objectivity of the statistical time series procedure.

Controlling for trend is both necessary and difficult. There is no objective way to determine 'what would have happened' to casualties absent a usage law. If possible, several methods should be used.

Belt Usage

Usage data before and after the law are required to compare with casualty data. For estimates such as (1) or (2), we need usage in the accident population, particularly the severe accident population. There are two principal ways to estimate this usage.

o Surveys of the driving population. Most countries conduct usage surveys before and after law changes, to measure the immediate effects of a law. But data from several countries suggest that the driving population has higher belt usage than the accident-involved population, which in turn has higher usage than the severe accident population. This is especially true if overall usage rates are low. One obvious reason is that belt surveys usually record daytime usage, nighttime usage probably is lower than daytime, and fatal or severe accidents frequently occur at night. In addition, some who are recorded as belt users in a driving population survey may be wearing their belts improperly -- for example, with too much slack. Improper use lowers belt effectiveness. Thus, driving population surveys may overstate the usage increase in the accident population due to a law.

o Accident data. Some countries record belt usage on accident reports. While the population is the proper one, the data are more questionable. Many accident victims have left their vehicle or could have removed their belt before a police officer arrives on the scene, so that their belt usage data are often self-reported. Given a belt use law, self-reported usage may be overestimated for all but the most seriously injured.

Either driving population surveys or accident data are likely to overestimate the accident population's usage change due to the law, which in turn overestimates the law's anticipated effect.

Casualties

Casualty reports and analyses may consider fatalities, serious injuries, or all injuries. A fatality is fairly easily and unambiguously defined, and fatality data are recorded quite accurately and consistently. But the number of fatalities affected by a belt usage change is frequently rather small, especially for smaller countries or jurisdictions over limited periods of time. Consequently, fatality counts can vary considerably due to random factors, making it difficult to estimate the effects of a belt use increase. Injuries are less clearly defined and less accurately and consistently recorded, but are much more frequent than fatalities. But a low injury threshold is inappropriate. A belted occupant may escape with minor scrapes and bruises when an unbelted occupant would have been seriously injured, but both occupants may be recorded as "injured". The belt has produced substantial benefits that will be invisible in a count of injured occupants.

How to Estimate

There is no single preferable method for estimating the effects of a belt usage change on casualties. All methods require judgment to estimate the required model parameters from incomplete and biased data, to take account of local factors, and to account for trend. Still, laws that produce large belt usage increases should produce noticeable casualty changes for the affected users, changes consistent with 40-50% belt effectiveness. In a longer time series a law should produce a sudden, one-time drop in affected user casualties unaccompanied by a similar drop in non-affected casualties.

Recall that we use "belt law performance" to describe the casualty reduction resulting from a belt law. To define this more precisely, belt law performance p is the equivalent effectiveness in equation (1) or (2) implied by the observed usage rates u1 and u2, casualty change Dc, and trend t. So, solve equations (1) and (2) for e, replace e by p, and obtain (3) and (4), respectively.

$$p = \frac{Dc}{(u2 - u1) + u1\,Dc} \tag{3}$$

$$p = \frac{Dc + t - 1}{(t\,u2 - u1) + u1\,Dc} \tag{4}$$

We thus calculate the belt law performance p implied by the reported casualty and usage (and, for (4), trend) data, given the assumptions of the two methods.

The calculated belt law performance is clearly inexact. It is based on aggregated usage and casualty data, often involving rather small samples, and on several assumptions. The goal is not to be exact, but to give a general idea of a usage law's effect. If the belt law performance lies generally in the 40-50% range, then the belt law performance is reasonably consistent with realistic expectations based on belt effectiveness in crashes. If the belt law performance is substantially higher, then the law has achieved more than anticipated (or other factors are responsible for some of the casualty change). If the belt law performance is substantially lower, then for whatever reasons the law has not yet achieved the results promised by belt effectiveness in individual crashes (or, again, other factors have been at work).

5. RESULTS FROM DIFFERENT COUNTRIES

We consider separately each country for which we have received either analyses of belt law effects or usage and casualty data. We calculate crude belt law performance estimates using (1) for each country. If some reasonable trend measure is available, we also use (2). Finally. we examine any detailed studies of each country's data.

Canada

Four provinces containing about three-quarters of the Canadian population implemented belt use laws in 1976 and 1977, while the remaining six provinces did not. Belt usage typically increased from about 25% before the law to about 70% after the law and then decreased somewhat over the next few years. Casualty reductions following the law were quite mixed, especially when compared with casualty changes in provinces with no law. An extensive report (Jonah and Lawson,. 1984) provides data and analyses. With occupant and non-occupant casualty data in law and non-law provinces, Canada provides data for examining various methods of estimating a law's effect.

The basic data from each province are provided in Table 1 (see Jonah and Lawson, Table 4). The casualty data are for fatalities over 11 years, 5 or 6 years pre-law (depending on the province) and the remainder post-law. The fatality column gives approximate total fatalities over the 11 year period. This gives some measure of the reliability of the fatality changes. The usage data are estimated for the same period. The aggregated usage figures are weighted by pre-law fatalities.

The diversity of results across provinces is immediately apparent. Ontario, with the greatest usage increase, was the only province to show a clear fatality drop. But Ontario non-occupant fatalities dropped almost as much as occupant fatalities. Quebec had the smallest usage increase, a modest fatality decrease, and a larger non-occupant fatality decrease. British Columbia and Saskatchewan had very similar experiences: moderate usage increases, virtually no occupant fatality change, but substantial non-occupant fatality increases. The four belt use law provinces together had decreases of about 10% for both occupant and non-occupant fatalities, while the 6 other provinces had no occupant fatality change but a similar 10% non-occupant fatality drop.

Table 1.
Canadian Belt Use Law Experience

Province	Usage Before	Usage After	Fatality Total	Fatality change Occupants	Fatality change Non-occupants
Brit. Col.	30%	50%	6,200	+ 0.2%	+ 14.4%
Ontario	24%	58%	13,100	- 20.5%	- 17.0%
Quebec	20%	39%	12,400	- 6.4%	- 13.1%
Sask.	25%	57%	2,400	+ 1.8%	+ 13.3%
4 law provs.	24%	50%	34,100	- 10.5%	- 10.2%
6 no law prov.	--	--	11,100	- 0.2%	- 10.4%

These data can be interpreted in more than one way. Consider only the aggregated data for the 4 use law provinces together. With no control, their 10% fatality drop is consistent with a 37% belt law performance. If non-occupant fatalities are used to determine the occupant fatality trend absent a law, then the law had no effect, as both occupant and non-occupant fatalities changed by essentially the same amount. If occupant fatalities in non-law provinces determine the trend, then the belt law performance of 36% is similar to the uncontrolled estimate, for there is essentially no change in non-law province non-occupant fatalities. Finally, as suggested by Jonah and Lawson, one may use the relative fatality change to determine trend. Without a law, assume that the difference between occupant and non-occupant fatalities would be the same in law and non-law provinces. Then, the law province fatality change would be 10.2 - (-0.2 + 10.4) = 0. The observed decrease of 10.5% again yields a belt law performance of 37%.

Similar analyses for each province are presented in Table 2.

Table 2.
Canadian Belt Law Performance, using as a control:

Province	none	non-law province occupants	same province non-occupants	relative
British Columbia	neg.	neg.	52%	76%
Ontario	53%	52%	12%	39%
Quebec	32%	31%	neg.	18%
Saskatchewan	neg.	neg.	29%	48%
4 law provinces	37%	36%	1%	37%

Clearly, none of the methods should be accepted without question, especially without taking account of random variation. We prefer the relative control, as it incorporates comparisons both with the law province non-occupants and the non-law province occupants. For the aggregate of 4 law provinces the method yields a 37% belt law performance, which is close to the lower limit of expectations based on belt effectiveness. For individual provinces, the British Columbia result is clearly unreasonable and Saskatchewan may be high, though both provinces have relatively few fatalities on which to base these results. Quebec, which shows the smallest law performance, is also the province with the least usage change following the law and the lowest post-law usage.

Injuries increased by 10% following the law in the four belt law provinces and increased by 16% in the remaining provinces, based on about 1,680,000 total injuries for 11 years in the belt law provinces and about 370,000 injuries in the non-law provinces. Non-occupant injuries increased by 12% in both law and non-law provinces. The resulting belt law performance estimates are:

uncontrolled:	neg.
control by:	
non-law province occupants	20%
law province non-occupants	8%
relative	20%

Again, we take the relative control as a summary measure. All the belt law performance estimates are substantially lower than generally accepted belt effectiveness figures. Though the "all injury" threshold is too low to measure belt performance in the severe crashes of greatest interest, still the injury reductions are less than had been hoped. Jonah and Lawson reach the same conclusions.

The Canadian study has three excellent features. It examines a large volume of data -- 10 times more casualties than are used for any other country. It includes at least five years before and five years after the law. It also compares provinces with a law to other provinces in the same country without. We have no reason to doubt its data or its conclusions.

Australia

On December 22, 1970, the Australian state of Victoria became the first jurisdiction in the world to require the use of seat belts. At that time approximately 60% of all passenger cars on the road were fitted with belts in the front seating positions (belts were required in all cars registered after January 1979). Usage was about 25% when belts were available, so that about 15% of all front seat occupants were belted. Results following the law are presented and analyzed in (Vulcan, 1977).

Surveys for the law's first five years show steady increases in belt availability and usage. The proportion of cars with belts rose from about 64% in 1971 to 94% in 1975, and usage of available belts rose from about 63% in 1971 to 86% in 1975 for front seat occupants. Overall usage thus increased from about 41% in 1971 to 77% in 1975. By 1980 belt availability rose to 99% and front seat usage to about 86% (Milne, 1980). A 1984 survey shows front seat usage at about 95% (Manders, 1984).

Casualties dropped substantially in the years following the law. Vulcan graphs vehicle occupant fatalities and injuries, a population close to that covered by the law. In the first year following the law, occupant fatalities dropped about 16% from the previous year and injuries dropped about 12%; other road user fatalities and injuries were approximately constant. For two years following the law, fatalities and injuries dropped about 14% and 15%, respectively, from the two year period before the law. Over five years the corresponding figures are a 9% drop for fatalities and a 16% drop for injuries. Other road user casualties are approximately constant throughout the period.

The Victorian speed limit was changed in December 1972 and other road safety measures followed. The two year comparison avoids the influence of these measures and yet allows a reasonable amount of data for analysis. With approximate usage of 15% before the law and 47% for the two years after the law, the casualty decreases imply a belt law performance of 41% for fatalities and 43% for injuries. Since other road user casualties are roughly constant, there seems to be no need to control for trend.

Other Australian states quickly followed Victoria's lead. South Australia's law became effective on November 29, 1971. An extensive analysis is given in (Crinon et al, 1975). The analysis compares the first year after the law with the year before. It concludes that overall usage rose substantially, occupant casualties were less severe, and occupant fatalities dropped by 7.5% (fatalities in 1967 and later models dropped 21%). Crinon does not present the usage data needed to calculate belt law performance.

Western Australia's law became effective on December 24, 1971. Results from one year before and five years after the law are given in (Court, 1977). Usage reported in accidents was 20% for the year before the law and 51% for the year after. Occupant fatalities increased by 38% the year after the law while injuries decreased by 12%. These casualty figures imply a negative law performance for fatalities and a 37% performance for injuries. Since the usage comes from accidents, not from driving surveys, these performance results are not directly comparable with others in this review.

New Zealand

New Zealand was the second country to enact and implement a belt usage law. In June 1972, belt usage became compulsory for drivers and front seat passengers of light vehicles registered since 1965 (when belt fitting was required). The law brought about an immediate increase in usage and a decrease in occupant casualties. Results are summarized in (Toomath, 1977).

Driver belt usage in vehicles with belts was about 32% in August 1971 and rose to 40% in May 1972, the month before the law became effective. Usage rose to 87% in June 1972 and remained above 80% through

1975 (the last data reported by Toomath). Passenger belt usage was 22% in August 1971, 28% in May 1972, and 62% in June 1972. Vehicles without belts made up 72% of the light vehicle fleet in June 1972. Overall, about 19% of all light vehicle front seat occupants were wearing belts during the two years before the law became effective and about 61% were wearing belts during the two years after.

Front seat occupant fatalities increased by 3% in the two years following the law compared to the two years before. However, gasoline consumption increased 12% and all other road user fatalities increased 56%. With gasoline consumption used to estimate the trend, the belt law's performance is 19%; with other road user fatalities used for the trend, the performance is 56%. About 60% of the other road user fatality increase is attributable to motorcycles and is concurrent with a 50% increase in registered motorcycles. With motorcyclists excluded, other road user fatalities increased 20%; with these fatalities used to estimate the trend, the belt law's performance becomes 31%.

Toomath gives driver injury data for one year before and after the law. For post-65 vehicles, all of which have belts, the fatal and serious injury rate decreased by 25%, while for pre-65 vehicles, most of which probably do not have belts fitted, the rate increased by 3%. With the pre-65 rate used as a control for trend, the belt law's performance is 43%.

Sweden

In January 1975, Sweden became the first Scandinavian country to implement a belt law. Usage and casualty data are summarized in (Norin et al, 1984).

Belt usage had been increasing gradually before the law to about 35%. Immediately after the law it rose to 84% and has remained above 80% thereafter.

Norin reports only summary casualty data for 1975, the year following the law. Based on about 600 occupant fatalities and 14,000 severe injuries annually, occupant fatalities dropped 12% compared to a trend curve based on fuel consumption, and severe injuries dropped 20%. With a usage increase from 35% to 84%, these casualty changes imply a belt law performance of 23% and 36%, respectively. These estimates may be high compared to those of other countries. As fatality rates per fuel consumed are generally declining, a control using fuel consumption may overestimate casualty reductions.

Denmark

Denmark introduced its belt law in January 1976 and achieved a usage increase from 19% to 67%. Casualty data from 1975 and 1976 are presented and analyzed in (Nordic Traffic Safety Council Report 37, 1984, Appendix II).

From 1975 to 1976, front seat car occupant fatalities decreased by 1% and serious injuries decreased by 11%, based on 640 fatalities and 15,525 injuries during the two year period. At the same time, all other road user fatalities increased by 6% and serious injuries increased by 3%. With no control, the fatality decrease implies a belt law performance of 1% and the serious injury decrease a performance of 22%. With the respective changes in other road user casualties used to determine the trend, the belt law performance is 13% for fatalities and 27% for serious injuries.

Report 37 analyzes the data using a different technique, based on belt use in accidents. It concludes that the best measure of trend is a 5% increase, based on serious injury increases to all road users excluding passenger car occupants. The Report then estimates a belt law performance of 6% for fatalities and 32% for serious injuries, with ranges of 26 to 38% for injuries and -40% to 52% for fatalities. The Report points out that the fatality results are highly uncertain as they are based on few observations. The Report's conclusions, based on reported belt use in accidents, are quite consistent with our belt law performance estimates based on belt use in the driving population. The Report's wide range for fatality performance emphasizes that results based on small counts should not be taken too seriously.

Norway

Norway introduced a belt law in September 1975, but the law was not enforced until a fine was introduced in September 1979. This enforcement raised usage from 59% to 87%. Casualty data from 1978 and 1980 are presented and analyzed in (Nordic Traffic Safety Council Report 37, 1984, Appendix II).

From 1978 to 1980, front seat car occupant fatalities decreased by 10% and serious injuries decreased by 24%, while all other road user fatalities decreased by 22% and serious injuries decreased by 9%. These reductions are based on 352 occupant fatalities and 11,166 injuries over the two years. With no control, the fatality decrease implies a belt law performance of 29% and the serious injury decrease a performance of 58%. With trends estimated from changes in other road user casualties, the performance is negative for fatalities and 44% for serious injuries.

Report 37's analysis estimates a 10% casualty decrease due to other causes, determined essentially from serious injuries to other road users. The Report finds a negative belt law performance from the fatality data and a 35-41% performance from the serious injury data. These results are generally consistent with our performance estimates. As with Sweden, the fatality results are based on small numbers of observations.

France

Unlike other countries, France took a gradual approach to belt laws. The initial law, in 1973, required use only for front seat occupants of cars placed in service since 1970, and only on rural roads. Over the course of the next six years the requirement was extended to 1968-1970 cars, to urban areas at night, to 1967-1968 cars, to vans, and to urban areas at all times. Throughout this period, measured belt usage increased gradually.

As a result of this gradual law introduction, no simple before-after comparison is possible. Even the initial requirement applies only to some vehicles and is further confounded by a speed limit change during the same year. Time series analyses (Lassarre and Tan, 1982; Lassarre, 1984) estimate substantial casualty reductions due to belt usage increases, in turn due to the use law. These imply a belt law performance of about 50%. But, due to the law's gradual imposition, this performance estimate cannot be associated with specific before and after law usage rates.

Israel

The Israeli belt use law came into effect on July 1, 1975. The law applied only to model year 1969 and later vehicles and only required usage on interurban roads. Usage and casualty data for 18 months before and 30 months after the law are reported in (Hakkert, Zaidel and Sarelle, 1981).

Usage on interurban roads increased substantially following the law. Observations from two interurban sites show usage of about 10% prior to the law and about 80% afterwards. Observations at a single urban arterial road show usage at about 5% prior to the law, an increase to 32% immediately following the law, and a return to 6% a year after the law's introduction.

Annual driver fatalities on interurban roads for 30 months following the law dropped 13% from the level observed during 18 months before the law, based on 220 total fatalities. Serious injuries rose 3% during the same period, based on a total of 928. During the same time period, driver fatalities on urban roads rose 23% and serious injuries rose 28%. Passenger data are not reported directly, but only estimated through a model.

A 13% fatality decrease implies a belt law performance of 19% with no control. If urban fatalities are used as a control, the performance becomes 41%. Since the annual number of driver fatalities is very small, these performance estimates are quite uncertain. For injuries, with no control for trend, a rise in serious injuries indicates a negative belt law performance. If the 28% rise in urban injuries estimates the trend for interurban, the performance is 27%.

Ireland

The Irish belt use law became effective on February 1, 1979. The available analysis (Hearne, 1981) compares the first 11 months following the law with same 11 month periods of 1979 and 1980.

Belt usage data are reported separately for National and other roads, while casualty data are reported for the entire country. Overall, belt usage approximately tripled after the law, from about 15% to about 45%.

The analysis compares occupant injury severity distributions before and after the law. Based on about 4700 drivers and 1900 passengers involved in accidents annually, it observes no injury severity change for all occupants with known belt use. As the proportion who were belted increased and the injury rates for belted occupants decreased slightly, the overall injury rates stay the same because the injury and fatality rates for the unbelted population have increased. There is a substantial amount of unreporting and also a substantial number of occupants with unknown belt usage in reported accidents. Without an accurate count of total fatalities before and after the law, even a crude belt law performance cannot be calculated for drivers. Passenger fatalities appear to have increased by 2% following the law, while serious injuries have decreased by 17%.

While no precise assessment can be made, it is clear that the law did not produce substantial casualty reductions. We accept Hearne's conclusion that "the effect of (the usage) increase on the severity of injury to car drivers was minimal". For comparison with other countries we use a belt law performance figure of 0.

Switzerland

The Swiss belt use law became effective on January 1, 1976, but was repealed in September 1977. The law was reintroduced, and became effective for the second time on July 1, 1981. Data over the past 10 years show passenger car occupant belt use at 70-85% during periods when the law was in effect and at 30-45% when it was not.

Casualty data are available for the 12 month period before and after the most recent law change, in July 1981 (Perisset, 1985). Based on 1043 fatalities and 30,246 injuries, passenger car occupant fatalities and injuries both dropped 15%. For usage of 37% before the law and 76% after, these casualty reductions yield a belt law performance of 35% for both fatalities and injuries. We have no data to estimate trends during this period.

A study of passenger car accidents in Basle at the time of the initial law (Hell, 1977) gives somewhat higher results. Usage of about 9% during 1972-1973, prior to the law, increased to about 76% in the year after the law. Occupant injuries decreased by 31%, while accident-involved occupants increased by 16%. With no control for trend, these data give a belt law performance of 44%, while if the trend is estimated by the 16% increase in accident-involved occupants, then the performance estimate is 58%.

As Hell's study is based on a single area and on smaller accident and injury populations, we take the 35% performance estimate from the recent uncontrolled data to summarize the Swiss experience.

United Kingdom

The United Kingdom's belt use law became effective on January 31, 1983, and immediately produced the highest belt usage rates ever reported for a country. Front seat occupant usage rose from about 40% during the year prior to the law to 95% for the year following the law. Usage remained at about 95% in 1984.

Usage and casualty experience for the first year following the law is analyzed in (Scott and Willis, 1985). The analysis is extended to data through December 1984 in (U.K. Department of Transport, 1985). The Department of Transport Report also contains an independent statistical assessment of data from the law's first 23 months by J. Durbin and A.C. Harvey. Both analyses use time series models of casualty data to estimate the law's effect, after controlling for the effects of trend, seasonal variability, and other factors such as traffic volume and the price of gasoline.

The two analyses reach similar conclusions: the law produced a 15 to 30% reduction in light vehicle occupant casualties. More specifically, the Department of Transportation estimates that car driver fatalities were 18% lower than predicted absent the law and serious injuries were 20% lower. Durbin and Harvey estimate driver fatalities to be 18% lower and serious injuries 23% lower. For comparison, actual car driver fatalities were 15% lower in the 23 months following the law than in the same 23 month period before the law, and serious injuries were 18% lower. Similar agreement holds for car passenger and light truck occupant casualties, all of which show reductions of 15 to 30% whether estimated by the Department of Transport, Durbin and Harvey, or direct comparison.

As a summary we use Durbin and Harvey's estimates, weighted by the number of pre-law casualties for car and light truck drivers and passengers. By this measure, the law reduced fatalities by 20% and serious injuries by 25%. With pre-law usage of 40% and post-law usage of 95%, these casualty reductions yield a law effectiveness of 32% for fatalities and 38% for serious injuries.

Germany

The Federal Republic of Germany required belts to be worn in 1976 but only introduced a fine for failure to wear belts in August 1984. Preliminary data (Marburger, 1985) comparing January-June 1984 with the same period in 1985 show that belt usage has increased from 58% to 92%. Car occupant fatalities have decreased by 25% while fatal and serious injuries together decreased by 20%. These casualty changes, with no control for trend, imply a belt performance of 51% for fatalities and 44% for serious injuries.

United States

New York was the first state to pass a belt use law. The law became effective on December 1, 1984, and was enforced after January 1, 1985. Surveys of the driving population showed usage of 16% in October 1984, indicating very little usage increase in anticipation of the law. Usage rose to 69% in January 1985 but then decayed gradually. Usage averaged about 57% for the first 9 months of 1985.

Preliminary fatality data from the first 9 months of 1985 show occupant fatalities in vehicles covered by the law down 6% compared to the same period in 1984 and down 17% compared to the 1980-1984 average for these 9 months. All other traffic fatalities in New York rose 2%

compared to 1984 and dropped 4% compared to 1980-1984. Preliminary data for the remainder of the United States show total fatalities up less than 1% in the first 9 months of 1985 compared to 1984 and down 5% compared to 1980-1984.

With 1984 as a base, these data imply an uncontrolled belt performance of 14%. With other New York fatalities used to estimate trend the performance is 18%, while with a trend estimated from all United States traffic fatalities the performance is 15%. If belt usage in New York is assumed to be 13% during the 1980-1984 period, the respective performance estimates are 37% uncontrolled, 30% controlled by other New York fatalities, and 29% controlled by total 30% controlled, United States fatalities. We take the single year figure of 15% as a conservative preliminary estimate.

Fifteen other states and the District of Columbia have enacted belt use laws this year, with thirteen laws to be effective by January 1, 1986. The 1986 usage and casualty changes from these states will provide additional examples of belt law effects in different jurisdictions.

6. DISCUSSION

The usage and performance data for each country are summarized in Table 3. Countries are listed in order of increasing post-law usage. The fatality results are highly variable, due possibly to the relatively small number of fatalities used in the various analyses (certainly true for smaller countries using a single year of pre-law and post-law data). Seven countries or states show belt law performance between 31 and 51%. Five, all based on fairly small fatality counts, are below this level (or even negative), and none is above. The injury results are more regular. All save one fall between 15 and 45%, even though different countries use different injury definitions.

The injury results suggest a trend of increasing belt law performance with increasing post-law usage. Figures 1 and 2 plot the calculated belt law performance for fatalities and injuries, respectively, against post-law usage. Figure 2 shows the trend quite clearly. The trend is consistent with the frequently-expressed hypothesis of 'selective recruitment': that as belt usage rises, each new group of users is successively more likely to be involved in potentially injury-producing accidents, so that belt wearing has an increasingly greater injury reducing effect.

Some belt law critics (Adams, 1981) argue that belt laws fail to produce anticipated casualty reductions because of individual risk compensation. This theory holds that someone compelled to use a safety device will compensate by increasing his driving risk, thus producing more accidents, holding his injury risk constant, and in the process producing more injuries to other road users. The data examined here show no consistent evidence to support this theory. Casualties to other road users sometimes rise and sometimes fall after a belt use law, and do not show the consistent rise required by risk compensation.

Table 3.
Belt Usage Changes and Casualty Reduction Performance of Belt Use Laws

	usage			fatality		injury	
Country or State	pre law	post law	years	count	perf.	count	perf.
Ireland	15%	45%	3	570	0%	4,900	0%
Victoria	15	48	4	2,670	40	71,000	42
Canada	24	50	11	34,000	37	1,700,000	20
New York	16	57	1	1,500	15	--	--
Denmark	19	67	2	640	13	15,000	27
Switzerland	37	76	2	1,000	35	30,000	35
Israel	10	80	4	220	41	930	27
Sweden	35	84	2	1,200	23	28,000	36
New Zealand	33	86	4	1,700	31	2,600*	43*
Norway	59	87	2	350	neg.	11,000	44
Germany	58	92	1	6,000	51	60,000	44
UK	40	94	4	7,700	32	106,000	38

years: total data collection period, pre-and post-law.
count: approximate number of occupant casualties during the data collection period
perf.: estimated belt law performance
injury: defined differently in different countries
* driver only, 2 years of data

In summary, we conclude:

- belt usage laws reduce casualties;
- belt law performance in reducing fatalities is quite variable, probably due to small numbers of observations and random variation;
- belt law performance in reducing injuries increases as belt usage increases, consistent with the 'selective recruitment' hypothesis; and
- fatality and injury reductions generally are consistent with a belt effectiveness of about 40% for 100% belt usage.

Figure 1.

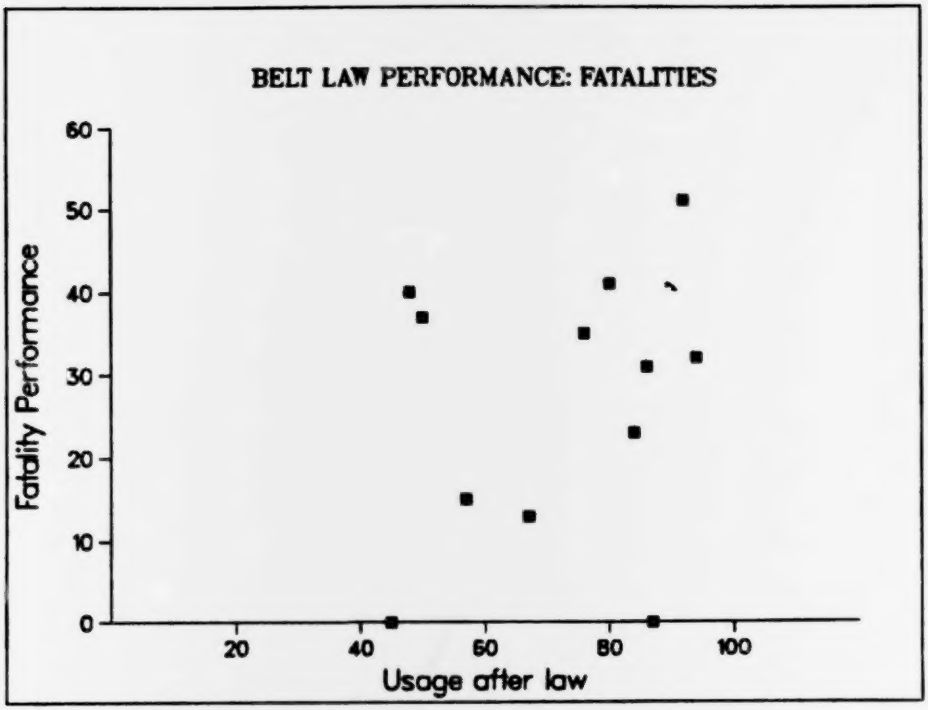
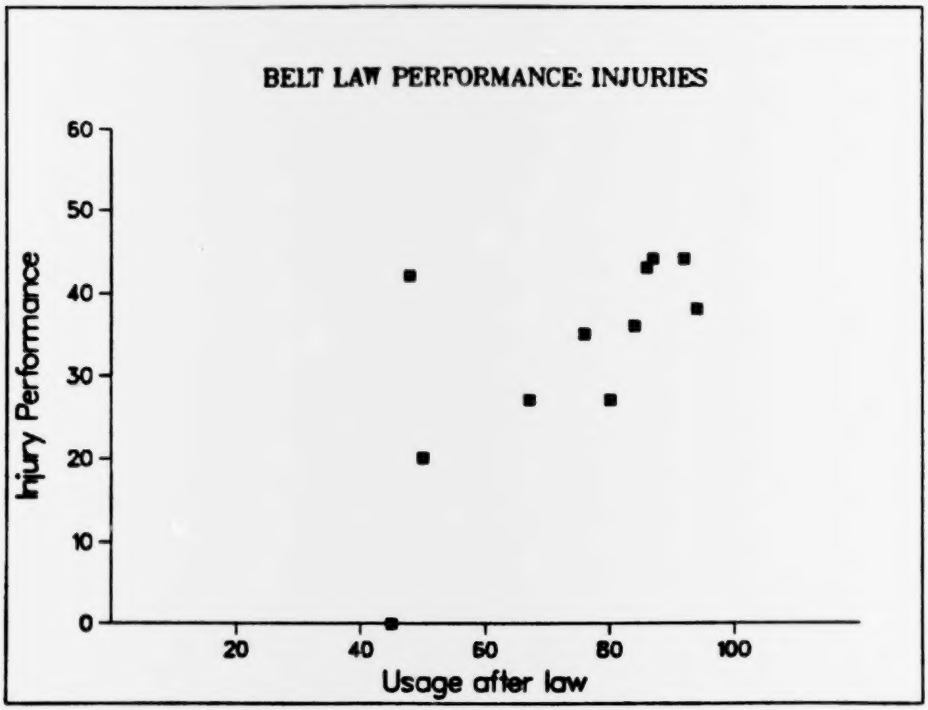


Figure 2.



7. RECOMMENDATIONS

o As belt laws are successful in reducing occupant casualties, and as belt law performance increases as belt usage rates increase, countries and jurisdictions should strive for use rates as high as possible. Recent Australian, German, and United Kingdom experience shows that rates above 90% can be achieved and sustained.

o Uncontrolled before-after casualty comparisons with limited data can give highly misleading impressions of a belt law's effects. Analyses should control for trend and for any other factors likely to affect casualties during the evaluation period. Analyses should use more than one trend control method, so that the effects of different assumptions, methodologies, and data sources can be examined.

o A country's belt law effect should be analyzed more than once. An initial analysis with at least one year of data should be followed by an analysis using three or four years of post-law data.

o All analyses require good belt use and casualty data, before and after a law. These data should be collected regularly and made available for analysis.

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REAR SEAT BELT USE AND EFFECTIVENESS FOR ADULT REAR SEAT OCCUPANTS IN CARS

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INJURY STATISTICS AND INJURY RISKS

The use of seat belts in cars has been a matter of interest for many years. This interest has mainly been focused on the front seat of the car and not the rear seat. One explanation could be that people in general believe that the rear seat is safer than the front seat. This point of view also seems to be present in the field of traffic safety research, regulations and information. A second explanation is maybe that there are much fewer rear seat occupants compared with front seat occupants. In this paper the injury risk and pattern is discussed as well as arguments and strategies to increase seat belt use in the rear seat.

Injuries to car occupants can be expressed in many ways; injury frequency, injury severity, injury pattern, long-term consequences, injury risks and fatality risks. As to adults in the rear seat it is important to describe the injury situation as it is somewhat different than for adults in the front seat and may give modified implications for protection.

The rear seat of a private car is not so often used as the front seat. In most countries passengers are not divided into front and rear seat occupants in the official road traffic accident statistics. From different sources it seems to be a fair estimation that 10-20% of all car occupants are rear seat passengers. It should, however, be noted that a big proportion of the rear seat passengers are children. Norin et al (1) showed that 40% of rear seat passengers involved in accidents (incl. uninjured) were children, 0-14 years old. HUK-data (2) showed that 22% of the injured rear seat passengers were less than 10 years old and 54% were under 20 years of age. Huelke and Lawson (3) found that among 877 rear seat occupants involved in frontal collisions, 45% were younger than 16 years old. Nygren (4) showed that 41% of the injured rear seat passengers were 0-14 years old. From these results it is obvious that children and adults must be separated when studying injuries to adult rear seat passengers.

A very important question concerning rear seat occupants is their injury risk compared with that of front seat occupants. Traditionally the rear seat position is considered to be safer than the front seat.

In literature there are results both rejecting and accepting the hypothesis about the rear seat being as dangerous as the front seat as to injury risk. The critical point seems to be if the age factor is taken into consideration. Table 1 shows injury frequency for occupants in the rear seat (unbelted) taken from a Volvo/TSV study (1).

Table 1. Injury Risk (Injured vs Injured + Uninjured) for Belted and Unbelted Rear Seat Occupants of Different Age in % (HAIS = the highest AIS)

Age	HAIS 1-6	HAIS 3-6
1-14	27.4	2.3
15-56	35.1	2.9
57-	47.5	3.6

Huelke and Lawson (3) also found that rear seat passengers of different age had different injury risks. 43.5% of the occupants aged 15 or younger escaped uninjured compared with only 23.5% for adults.

Comparisons of the relative hazard of front and rear seat positions, not taking the age factor into account, seems therefore to be inadequate. However, some studies made seem suitable for drawing conclusions about relative risks. Huelke and Lawson (3) showed that for adults there were no significant difference in injury risk between adult front and rear seat occupants. Table 2 shows the injury risk in Volvo cars (1) for unbelted occupants 15-57 years old.

Table 2. Injury Frequency (Injured vs Injured + Uninjured) Aged 15-57 Years Old for Different Seating Positions. Unbelted. N=number of injured and uninjured occupants.

	AIS 1-6	N	AIS 3-6
Driver	35.2%	1,118	2.7%
Front seat passenger	38.6%	368	2.5%
Rear seat passenger	35.1%	835	2.9%

As can be seen there is almost no difference in injury risk for the different seating locations when occupants of the same group are compared. It was calculated that the injury risk for persons between 15-27 years old was rather stable. Similar results were found in another study (5).

The injury severity in the rear seat is comparable to the front seat though some authors have found a slightly lower degree of severity.

Huelke and Lawson (3) found that the severity was similar for adults although a higher belt use may be present in the front seat.

Norin et al (1) showed that the incidence of injuries classified as HAIS 3-6 were as common in the rear seat as in the front seat (table 4) for unbelted occupants.

Nygren (4) found the degree of severity among unbelted rear seat occupants to be slightly lower compared with front seat occupants mainly due to a smaller proportion of killed rear seat occupants.

Mellbring et al (6) found the same tendency and so did Andersson et al (5). Center position of the rear seat may give a lower risk of injuries than rear seat outboard position. Walz and Niederer (7) also found that the severity was lower for the center position.

Dalmotas et al (8) showed that for unrestrained adults the risk of major/fatal injuries was equal for the front and rear position.

The risk of medical disability does not seem to differ for front and rear seat occupants (4). Compared with front seat passengers, rear seat passengers seem to have a similar injury pattern. Facial injuries and injuries to the upper parts of the lower extremities seem, however, to be more rare among rear seat occupants which might explain the fact that injured rear seat occupants receive a slightly less number of diagnoses per person (4).

Injury causing structures are often front seats, roof and side structures (7). Ejection also seems to be a problem for adult rear seat passengers (7).

The question of overload to front seat occupants caused by unrestrained rear seat occupants has been studied both experimentally and, though in many cases with questionable methods, in real life accidents.

Faerber (9) as well as Roberts (10) found in experimental studies that unrestrained rear seat occupants increased the risk of injuries to front seat occupants and that restrained rear seat passengers lowered the risk. Accident studies show that these results are reliable in real life. There are numerous single cases where overloading was present.

Lowenhielm and Krantz (11) found that in severe head-on collisions belted front seat passengers were more severely injured if a rear seat passenger was present.

Wild et al (12) found that unrestrained rear seat occupants did not affect the injury risk and severity for belted front seat occupants but did so for unbelted ones. The authors did not take into account the seating position in the rear seats.

Nygren et al (13) found what they called the "rucksack" effect to be present. By combining positions in the car with impact direction and with the criterion that the adult rear seat occupant was injured they found a more than 50% increased risk of injuries to front seat occupants in frontal collisions. This was only true when the rear seat passenger was sitting on the same side as the front seat occupant. The result was highly significant. The injury severity was not significantly increased.

The following conclusions can be drawn:

1. Many authors have found the rear seat to be as hazardous as the front seat comparing unbelted occupants if age is taken into account.

2. The injury severity is slightly lower for rear seat passengers.

3. The injury panorama is similar in the front and rear seats.

4. Overloading seems to be a problem not only in experimental studies but also in real life accidents.

5. The unrestrained rear seat occupant causes two problems by both receiving injuries himself and by causing injuries to front seat occupants.

Seat Belt Use Among Adults in the Rear Seat

Compared with the front seat the use of seat belts in the rear seat is in most countries far lower. Among those countries that have not introduced mandatory seat belt use in the rear seat the use varies between 1-25% where most countries have a use below 5%. However, it is important to know that in many countries cars do not have to be equipped with belts in the rear seat. Furthermore, only lap belts are required in some countries. Table 3 gives the status of equipment, belt use legislation and belt use levels gathered from the OECD questionnaires.

Table 3 Mandatory Fitting and Use of Seat Belts in Different Countries

	Mandatory equipment	Mandatory Use	Usage rate
Australia	Yes (3 pts since 1979)	Yes since 70-72	60% (Victoria 80%)
Austria	Yes since 1984	Yes if mandatory equipment	<5%
Belgium	No	No	0%
Canada	Yes	* 1)	18-50%
Denmark	No	No	0%
Finland	Yes	No	5-6% in cars with belts
France	Yes since 1978 3)	No	0%
Ireland	No	No	n.a.
Italy	No	No	<1%
Netherlands	No	No	n.a.
New Zealand	Yes (3 pts since 1979)	Yes since 1972	15%
Norway	Yes since 1985	Yes if mandatory equipment since 1985	<10%
Sweden	Yes (3 pts since 1970)	No	20%
Switzerland	Yes	No	n.a.
Turkey	No	No	n.a.
United Kingdom	No	No	n.a.
United States	Yes (lap belts)	No 2)	2.5% all US
West Germany	Yes since 1979 3)	Yes since 1984 >12 years	20-30% post-law

1)Depending on State, New Brunswick, Nova Scotia and Ontario has mandatory use
2)Except New York State
3)3 pts belts in most cars.

Car manufacturers rarely install seat belts in the rear seat in cars sold in countries where this equipment is voluntary. If belts are installed, they are of varying types.

One of the most interesting places concerning seat belt use in rear seats is Victoria in Australia. The state of Victoria introduced mandatory seat belt use in rear seats for both children (over 8 years old) and adults in 1970. A survey conducted in 1980 showed that belt use in the rear seat was only 19% compared to 85% in the front seats. The reasons for the low belt use were found to be (14) among others the following:

1. The rear seat was thought to be safer than the front seat.

2. The rear seat had a poorer design of restraints than the front seat.

A campaign was conducted aimed at increasing belt use in the rear seat and at the same time introducing compulsory wearing for children 0-8 years old. There was a drastic increase in belt use eight months after the campaign. Table 4 shows belt use for different ages before and after the campaign.

Table 4. Belt Use for Different Age Groups before and after the Campaign in Victoria, Australia

	Belt Use In The Rear Seat	
Age Group	Before Campaign	After Campaign
0-7	65.2	90.9
8-13	31.0	80.5
14-17	28.4	69.7
18-29	24.0	68.4
30-49	26.5	74.9
50-	43.0	83.2
All	39.5	80.0

Especially the Victoria campaign shows that seat belt use in the rear seat among adults can increase up to a level where many countries are satisfied both belt use in the front seat.

In Sweden campaigns during 1980-1985 have increased seat belt use in the rear seat (15) from 2-3% up to 20%.

For both Australia and Sweden facts about rear seat belt use have been concentrated on both injury risk for the rear seat passenger himself as well as the risk of the occupant sitting in the front seat (rucksack effect).

Nygren and Tingvall (16) showed that a reduction of the motor third party liability insurance premiums for those policy-holders that could guarantee belt use among all occupants in the car (both adults and children) was very effective to increase belt use in the rear seat. Of the actual population 16% of the policy-holders signed a contract where they guaranteed belt use for a rather modest premium discount (10%).

The belt use of the group signing this contract was high also in the rear seat (90%). For the group not signing a contract the belt use was around 20% thereby indicating a fairly high increase in belt use in the rear seat. Injury statistics showed very good results.

The following conclusions can be drawn:

1. Mandatory fitting of rear seat belts does not exist in all Countries.

2. Belt use in the rear seat is very low in most countries.

3. Belt legislation for adult rear seat occupants has, in those countries where a law exists, been introduced fairly recently. The experience of such a law is therefore limited.

4. In Australia with the longest experience, seat belt use in the rear seat is 60%, but in the state of Victoria after a special campaign the use has increased to 80%.

5. In Sweden where belt use in the rear seat is voluntary the use is about 20%.

6. In both Victoria and in Sweden the "double reason concept" has been used. By "double reason" is meant that both the situation for the rear seat passenger himself and the front seat occupant is described.

7. Economic incentives from insurance companies have proved to increase belt use in the rear seat with no costs to the insurance companies as costs for injury compensation was lower.

Restraint Effectiveness for Adults in the Rear Seat

Due to the low use rate of seat belts in most countries and the fact that the number of rear seat passengers are far less than front seat passengers, the number of studies dealing with restraint effectiveness are few. Furthermore, when effectiveness is calculated adults have in many cases not been separated from children inducing misleading figures.

Norin et al (1) showed that seat belt use among adults 15 years) in the rear seat was 28% effective which was equal to front seat effectiveness. In the same study it was shown that restraint use for children was 52% effective. Mixing the groups together can, therefore, be inadequate. The difference in effectiveness was significant, while the estimations lacked from high precision due to a limited number of accidents where rear seat passengers used seat belts.

Preliminary results (17) show that rear seat belt use among adults probably is slightly more effective than front seat belt use.

A Canadian study (8) showed that the risk of severe or fatal injuries was reduced by 40% for occupants 15 years or older which was similar to front seat effectiveness.

Effects of increase of seat belt use in the rear seat for adults in connection with legislation has been evaluated by Lane et al (14) in Victoria, Australia. During a campaign, legislation having been enforced 10 years previously, the use of belts in the rear seat increased from 39.5% to 80.0%. The increase of belt use led to a decrease in the number of killed and injured adult rear seat occupants by 17% while the number of killed or injured front seat occupants was almost constant.

As to the Canadian, as well as the Australian study, lap belts seem to be most common. There is, however, no study estimating differences in effectiveness for lap belts/shoulder belts only compared with lap/shoulder belts (2pts vs 3pts). Such estimations have been conducted for the front seats (e.g. Huelke) indicating lower effectiveness for 2pts belts compared with 3pts belts. Case studies based on very limited data show that there exist belt use induced injuries from lap belts only in the rear seat. In most countries, especially in Europe, it is not possible to equip cars with lap belts only on the outer positions. In e.g. the U.S.A., it is on the other hand possible to sell cars with only lap belts for all positions in the rear seat. However, a number of car manufacturers only sell cars with three point belts on the outer positions also in the U.S.A. Controlled studies can, therefore, be made.

Swedish insurance data indicate that rear seat belt use is at least as effective as front seat use.

A discussion based on the knowledge of restraint effectiveness leads us to the conclusion that rear seat belt use is at least as effective as front seat belt use also when 2pts belts are considered, although a certain difference in this matter can be present. Injuries to rear seat occupants are caused less by intrusion than by mere contact (12, 19, 18) where seat belts are effective. Furthermore, the following conclusions can be drawn:

1. Although there are very few studies on seat belt effectiveness for rear seat occupants the effectiveness seems to be similar to or slightly better compared to that of front seat occupants.

2. Knowledge about front seat occupant effectiveness and rear seat occupant injury mechanism and pattern as well as data on intrusion lead to the conclusion that seat belt use among adults in the rear seat is at least as effective as use in the front seat.

3. A marginally higher seat belt use in the rear seat among adults when legislation is enforced leads to a decrease of the number of injured and killed occupants.

4. Experimental studies show that overloading by rear seat occupants on front seats is reduced by the use of seat belts in the rear seat.

Future Strategies to Increase Seat Belt Use for Adults in the Rear Seat

It is obvious that there exists a great potential in increasing seat belt use in the rear seat for adults.

Adult rear seat occupants count for about 10% of all car occupants and have apparently the lowest belt use of all car occupants worldwide.

Although there are few studies, it seems that the injury risk and the injury severity is similar to unbelted rear seat occupants and unbelted front seat occupants. Furthermore, overloading or rucksack effect seems to be not only a theoretical but also an empirical event that causes a substantial risk of injuries to front seat occupants.

Both the injury risk and the injury-causing risk are critical factors as they can be used for both information and legislation. The "double-reason" concept has been used in Sweden with fairly good results as belt use among adults in the rear seat increased from 5 to 20% in four years only by using information.

Another critical factor is fitting of seat belts in the rear seat. In many countries there is no mandatory fitting and furthermore lap belts are only required in some countries.

Belt effectiveness does not seem to be lower for rear seat occupants than for front seat occupants. Including a decreased risk of overloading restraint effectiveness is even better for rear seat belt use.

An example from Victoria, Australia, 14) shows that legislation can be very successful with a usage rate close to that for the front seat. Injuries were shown to decrease as a result of increased belt use.

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EFFECTIVENESS OF CHILD RESTRAINT LAWS

M. DEJEAMMES
C. TINGVALL
A. NYGREN

All over the industrialized world, the fatality risk for children has dropped dramatically during this century. While at the beginning of the century, different kinds of diseases were the most common cause of death, accidents have recently increased their proportion. Today, accidents are the most common cause of death for children, among which traffic accidents are in the majority.

During the past 20 years, efforts have been made in many countries to improve the safety of child passengers in cars, mainly by providing and requiring appropriate restraint devices.

This report presents an overview of injuries to children, child safety laws and child restraint system design, use and effectiveness.

INJURIES TO CHILDREN

Road traffic accidents produce a high risk of fatality and injury for children, especially children in cars. In some countries almost 50% of the children, 0-6 years old, killed in traffic accidents were car passengers. This proportion is lower for older children. But in all countries surveyed, 15-40% of all children 0-14 years old, killed in traffic accidents were car passengers (Table 1). Among young children, 0-2 years old, almost every fatal traffic injury occurs in cars.

Table 1. Total number of children killed in traffic accidents and number of children killed as car passengers in road traffic accidents for OECD countries with adequate data available (UN statistics) for 1982

	Total number killed				Car passengers				% killed
	0-5	6-9	10-14	Total	0-5	6-9	10-14	Total	in cars
Austria	29	21	34	84	6	4	9	19	23
Belgium	43	45	55	143	19	11	12	42	29
Denmark	15	16	26	57	8	2	3	13	23
Finland	13	10	20	43	5	1	4	10	23
Greece	34	39	40	113	9	8	4	21	19
Iceland	0	0	2	2	0	0	1	1	
Ireland	32	11	25	68	2	1	2	5	7
Italy	115	126	226	467	44	31	60	135	29
Japan 1) 2)	422	211	157	790	55	23	27	105	25
Netherlands	49	39	86	174	12	5	9	26	15
Norway	12	10	17	37	1	0	5	6	16
Spain	124	102	102	328	54	42	39	135	41
Sweden	15	14	21	50	8	4	6	18	36
Switzerland	17	29	28	74	2	2	5	9	12
United Kingdom	140	138	238	516	29	18	31	78	15
United States	1201	757	1197	3155	555	190	362	1107	35
West Germany	232	239	256	727	73	32	58	163	22

1) Age group <6, 7-12 and 13-15 years old
2) 1983

Increased interior safety of cars together with higher adult belt use due to legislation in many countries has improved safety for adult car occupants. The relative safety of children compared to adults in cars has decreased as children are more often unrestrained than adults.

There are few studies from which it is possible to compare injury risks for different ages with no interaction from other factors. It was, however, shown by NORIN (1980) there there were considerable risk differences and that the injury risk was highly correlated to age. Among unbelted car occupants the injury risk was 22% lower among occupants 1-14 years of age, compared to the age group 15-56 years. A matched sample from Volvo (NORIN-1979) of children and adults from the same accidents showed that for unrestrained passengers in the rear seat the injury risk was 36% lower for children.

Preliminary studies from Folksam (ALDMAN) show a decreasing risk for lower ages among children. (PARTYKA (1984) showed, however, that children below 1 year old are more prone to be injured and killed than children aged 1-4 years.

Injury risk differences between children and adults possibly can be explained both by size and weight differences and by differences in their physical ability to withstand high forces.

Injury severity measurement for children also differs from adults. First, the expression of injury severity in AIS and ISS is based mainly on adults. BULL (1975), showed that the fatality risk for a given severity score was lower for younger people. NYGREN showed that the severity in ISS was lower for children than for adults. GARVIL showed that AIS levels were generally lower for children than for adults.

Permanent impairment of disability for children does not seem to have been studied often. KRUSE showed that the incapacitation time for a given HAIS (highest AIS) was strongly correlated to age. Physical disability was shown to be more rare among young people (including children) by NIELSEN (1981). NYGREN showed that the risks of permanent medical disability among injured car occupants were 8 times higher for an adult than for a child. Disabling injuries among children occurred only to the head.

Injury patterns are quite different for children compared to adults and are also heterogenous for children of different ages. It appears that head and face injuries are far more common among children compared with unrestrained adults. Table 2 shows the injury panorama for adults compared with children with 80% belt use among adults and low restraint use among children. Injuries to the extremities, neck and chest are far more rare among children than among adults.

ASHTON concluded that as the age of the child increased, the overall incidence of head injuries decreased, and that all injured children up to 1 year old received injuries to the head.

The high risk of head injuries among children is probably due to the fact that a child's head is a greater proportion of its body than an adult's head and that the cranium is more vulnerable among children. Other body regions, like the chest, are thus more flexible on children (NIELSEN).

Table 2. Injury panorama for car occupants of different ages in percentage. Source Folksam (ALDMAN)

Body Region	Adults	0-5 years	6-10years
Skull/brain	25	45	45
Face	18	54	42
Neck	20	5	7
Arm	19	10	15
Leg	25	15	13
Chest	20	4	4
Abdomen	5	4	9
Back	7	1	5

The main cause of death among children is head injuries. In a study by NIELSEN, 68% of the deaths were caused by head injuries. The second most common cause was injury to the neck. Among adults, chest injuries are almost as common a cause of death as head injuries among children (NYGREN).

Injuries among children are mainly caused by contact with the interior surfaces of the car. Among unrestrained children PARTYKA (1983) showed that instrument panel (including the glove compartment area) and front seat back were the most common contact areas for both low and high severity injuries. Non-contact injuries are rare. Ejection is often given as a reason for severe and fatal injuries to children. NIELSEN showed that among children killed, 38% were ejected. VOLVO reported that among 65 children killed, 20 (31%) were ejected, of which 15 were ejected from the rear seat, 2 from the front seat and 3 from the luggage space in station wagons.

The position in the car of unrestrained injured children varies between different countries, but the rear seat is generally the most common location.

PARTYKA (1983) concluded that sitting on an adult's lap appears to increase the risk of serious injuries. DEJEAMMES showed that the death rate was higher for children sitting in the front seat compared to rear seat occupants. ROY (1980) showed that intrusion in the car compartment was more common in the front seat than in the rear seat.

The following conclusions can be drawn:

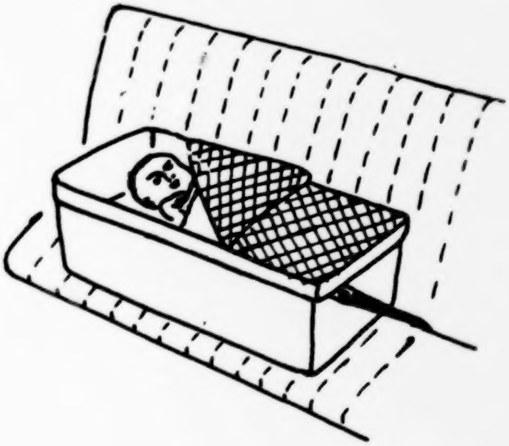
- Children are less likely to be injured than adults
- Injuries to children are less severe than injuries to adults
- Children are less prone to be medically disabled
- Injuries to children are primarily to the head
- The main cause of death among children in cars is skull and brain injuries
- Children often receive severe injuries when ejected
- Other injuries are nearly always the result of a contact between the child and the interior of the car
- It is obvious that the total health of children can be dramatically increased by reducing the risk of serious and fatal injuries in cars.

CHILD RESTRAINT SYSTEMS

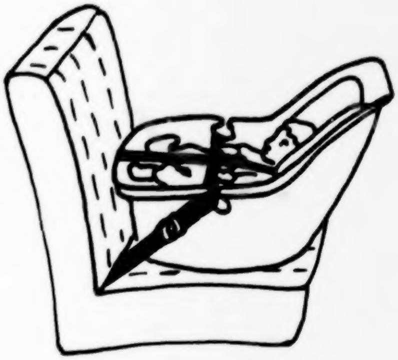
The solutions conceived and applied to protect children in cars are based on the restraint principle. Understanding the difficult of restraining children who seethe with activity, researchers, mainly in car manufacturers' laboratories, have considered using energy absorbing materials in order to build up a "welcoming" passenger compartment. But these attempts resulted in fixtures which diminish the car's interior volume too much and are not suited for the wide range of passengers' stature to be protected.

So child safety devices are system adapted to a child's stature which contain the child with the aid of straps. Their design is determined by the child's growth: infants up to 9 months or 1 year of age who must travel in a lying posture must be distinguished from children who are able to remain seated in the car. All over the world, there exists a large variety of child restraint systems. This variety is determined by the standard regulations to which the restraints must comply and which have been worked out with reference to the parents needs and habits as well as the car equipment.

- Infant restraint systems: two types are the most frequent:

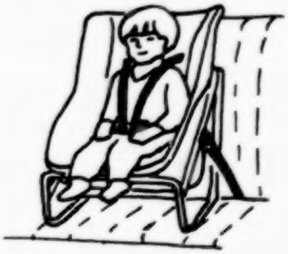


. carry-cots which are secured to the car by special straps and which include anti-ejection features such as nets.

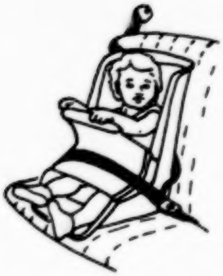


. rearward facing shells secured by the car safety belt or by special straps. The infant is placed in a semi-lying position and is restrained by a harness.

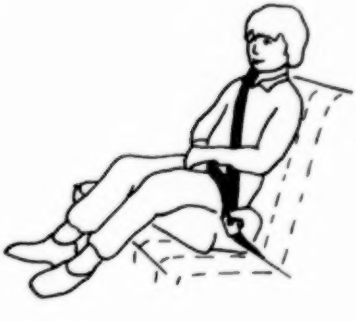
- Child restraint systems: the systems are small bucket seats with generous lateral supports, if they are designed for the smaller children, or cushions. They are secured by the car safety belt or by special straps. Different types are:



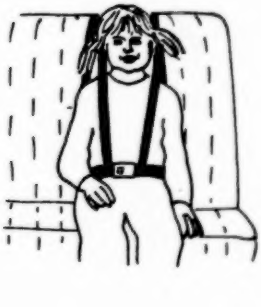
HARNESS BUCKET SEAT: some makes have their shells reclinable to help the child sleeping. They are secured to the car either by the lap belt, with an additional top tether strap in some instances, or by special straps. These systems are designed for either forward facing or rearward facing seating positions.



SHIELD SEATS: the child is retained in the shell by a shield whose table can distribut the load on the child during a crash. The unit is secured to the car either by a lap belt or by special straps.



BOOSTER CHAIRS OR CUSHIONS: the chair or the cushion is designed to provide sitting comfort to the child who is restrained by a three point belt or by a special harness.



HARNESS AND CHILD BELTS: four strap harnesses and three point belts are designed for older children. They are secured to the belt anchorage points of the car and/or to additional anchorage points.

SAFETY LAWS FOR CHILDREN IN CARS

Many industrialized countries concerned with reducing road traffic fatality and morbidity have enacted laws concerning the transport of children in cars. Partly because of differences in mentality and responsibility between children and adults, these laws present a wider range of features than laws for adult protection. Among the 17 countries which responded to the OECD questionnaires, the following provisions have been included, to require children:

> either to use a proper restraint system,
> or to use the adult safety belt,
> or to travel on the rear seat.

- Mandatory use of child restraints (Table 3): 7 countries require the use of a restraint system when a child is seated in the front seat. This provision applies to children whose age depends on the country: from 0 to 4 years of age (in many states of the USA for example) or from 0-14 years of age in the U.K. In some states of 3 countries (USA, Canada, Australia), the provision also applies to children travelling in the rear seat.

Table 3. Mandatory use of child restraints

COUNTRY	EFF.DATE	AGE	PLACE
Australia	1976-1980	0- 8 yr	Front and Rear
Austria	1978	0-12 yr	Front
Canada	1982-1983	9-22 kg	Front and Rear
Finland	1984	0-15 yr	Front
Netherlands	1977	0- 4 yr	Front
U.K.	1983	0-14 yr	Front
U.S.A.	~ 1982	~0- 4 yr	Front and Rear

- Mandatory use of adult safety belts (Table 4): 8 countries require a child to be restrained by the safety belt provided for adults in cars. In 3 of these countries this provision applies only to children in the front seat. Some countries require younger children only to use lap belts.

Table 4. Mandatory use of adult belts by children

COUNTRY	EFF DATE	AGE	PLACE - RESTRAINT
Australia	1976-80	~>1 yr	Front & Rear
Canada	1982-83	~3,6 yr	Front & Rear - Lap
		>5 yr	Front & Rear - Seat Belt
Finland	1984	0-15 yr	Front
Ireland	1979	0-12 yr	Front
Netherlands	1977	4-12 yr	Front & Rear - Lap Belt
New Zealand	1978	8-14 yr	Front & Rear
	1984	0- 7 yr	If Practicable
U.K.	1983	1-14 yr	Front
U.S.A.	1983	~3,5 yr	Rear (12 States) Front (26 States

- Mandatory travel of children in rear seats (Table 5): in 3 countries, this provision applies in all circumstances to every child up to the age of 10 or 12 years. In 4 other countries, the provision applies only if the child cannot be restrained when seated in front.

Table 5. Mandatory travel of children in rear seats

COUNTRY	EFF. DATE	AGE	RESTRAINT
Austria	1978	0-12 yr	If no restraint at front
Belgium	1975	0-12 yr	Rear
France	1975	0-10 yr	Rear
Germany	1984	0-14 yr	Rear
Netherlands	1977	0-12 yr	If no restraint at front
New Zealand	1984	0-12 yr	If no restraint at front
U.K.	1983	0-14 yr	If no restraint at front

SAFETY REGULATIONS FOR CHILD RESTRAINT SYSTEMS

Road accident investigations have shown that child seats designed for use in the home often are unable to withstand the crash loads in a car. The first countries to address this issue required some minimum static strength of the child restraint system. Now the standard regulations (only recently required in some countries) include a dynamic test simulating a frontal crash at 50 km/h. Countries differ on some provisions concerning the following main points:

- child restraint system installation (car seat simulation, simulation of a support for rearward facing systems, anchorage points)
- child and infant dummies,
- test simulating a rear-end crash for rearward facing systems,
- test simulating a car over-turn,
- performance criteria and biomechanical criteria.

Table 6 presents the standard regulations that have been enacted and indicates the children age or weight groups and the types of restraint devices that are the most common. In fact these regulations fall into three groups of very similar regulations. These are the regulations of:

- Europe, France and Nordic countries
- USA and Canada
- Australia, New Zealand and United Kingdom.

As it can be seen, one difficult point is to find a single parameter which could indicate by what child a restraint system can be used. The reference to age in the mandatory use laws, to weight or size for the safety regulations may confuse most of the parents when they have to chose the restraint system convenient to their children.

Table 6. Safety Standard Regulations

COUNTRY	STANDARD	GROUPS	RESTRAINT TYPES	POSITION
Australia	AS 1754	0- 9kg	Infant Seat	Forward
		9-19kg	Child Seat-Harness	or
		9-38kg	Booster Cushion	Rearward
Canada	MVSR 213	0- 9kg	Infant Seat	Forward
				or
		9-22kg	Child Seat	Rearward
Denmark	DS 2190	0- 9mth	Carry-Cot	Forward
	(+ECE 44)	9mth-4yr	Child Seat	or
		> 4yr	Booster Cushion	Rearward
Finland	ECE 44	0- 9kg	Carry-Cot	Forward
Sweden	+Swedish T	9-18kg	Child Seat	or
		15-25kg	Booster Cushion	Rearward
		22-36kg		
France	Arrete	0- 9kg	Carry-Cot	
	2 Sept. 75	9-18kg	Child Seat	Forward
		>15kg	Harness	
Germany	ECE 44	9-18kg	Child Seat	Forward
		15-25kg	Harness	or
		22-36kg	Booster Cushion	Rearward
Netherlands	ECE 44	0- 9kg	Carry-Cot	Forward
	+Dutch	9-18kg	Child Seat	or
		15-25kg	Booster Cushion	Rearward
		22-36kg		
New Zealand	NZS 5411	0- 9kg	Infant Seat	Forward
		9-19kg	Child Seat	or
		15-36kg	Harness-Booster	Rearward
Norway	ECE 44	9-18kg	Child Seat	Forward
		15-25kg	Booster Cushion	or
		22-36kg		Rearward
U.K.	BS AU 186	0- 9kg	Carry-Cot	
	BS AU 157a	9-36kg	Child Seat	Forward
	BS AU 185	>15kg	Booster Cushion	
U.S.A.	FMVSS 213	0-22kg	Carry-Cot	Forward
			Child Seat	or
			Harness	Rearward

INCENTIVES FOR CHILD RESTRAINT SYSTEMS USE

The various countries concerned with improving child car occupant safety have realized that they must promote child restraint system use. There are two ways to do this: through information provided to parents and children and through mandatory use laws.

Restraint systems such as adult safety belts are perceived as accessories, whose use must be justified. For children in their first years of life it is necessary to provide special restraints, adapted to their morphology and physiology, for their travel in cars. These restraints afford substantial crash protection in addition to their positioning function. It is therefore important to get parents concerned about the safety aspects of child restraint systems and to make the devices acceptable by children.

With regard to mandatory laws for child restraint use (or child seating position in the car), it appears, from the answers to the questionnaire, that the countries which enacted such laws do not enforce them severely with inspections and fines. Countries instead use incentive programs to promote restraint system use.

1. - Information Materials: the information materials used in various countries include the following:

o Nationwide campaigns are through mass media such as television and radio and taken up by the local and regional press. These large campaigns are quite expensive but can bring the message to a large audience. Frequently, they are used to publicize a new law or a new safety standard.

o Target information for parents and children is transmitted by leaflets, stickers, and similar devices The target population can be reached in appropriate places and circumstances,: for example in child health prevention centers, medical centers, maternity hospitals, child welfare agencies, and schools. Informative posters, films, and demonstrations can be presented during commercial exhibitions.

o Education programs deliver information directly to parents and children. Such programs transmit detailed information by demonstrating the available devices and by familiarizing parents with the instructions for their correct use. Countries such as New Zealand and USA have established parental education programs in maternity hospitals and health care centers.

o Lending or renting restraint devices is an interesting way to promote use. Child restraint devices are often expensive and, during the ten first years of a child's life, three to four different devices are necessary to adapt to its changing stature and needs. In countries such as the USA, Canada, and New Zealand, loaner programs for lending or renting have been organized by many public institutions and local communities.

2. - Information content: the large campaigns, especially on TV, transmit a quite concise message with an advertising style. The content is usually limited to advice on usage such as "Protect your child", or "Keep your child in a restraint device".

The information given to target audiences of parents and children explains the reasons why a child should be restrained in a car, describes the restraint devices and gives advice on their use. In some instances, the message is directed to correct misconceptions. It must be noted that the leaflets and posters avoid extreme fear tactics, such as bloody pictures of road accidents. They are intended rather to help parents and children to understand the usefulness of restraint devices and to give examples of restraints.

3. - Financing: nearly all countries which require child restraint use have financed nationwide campaigns at least on one occasion. But it is interesting to notice that in many countries child safety mobilizes the cooperation of various private institutions which help finance information campaigns. These include for example:

- manufacturers of restraint devices which allocate a part of their publicity budget for informing customers (in Nordic countries, New Zealand, Germany),

- social associations whose purpose is to make parents more concerned about their children's safety (in USA, Canada, Australia),

- insurance companies which include this topic in their prevention actions (in Noric countries, Switzerland, Germany).

4. - Effect of incentive programs: as for many other topics, the evaluation of child restraint system usage programs is not regarded as necessary. Do nations satisfy their consciences with just information campaigns? Is the lack of evaluation a sign of defeatism?

Nevertheless, some evaluations beyond simple counting can be undertaken. They can be aimed at qualifying and quantifying the relevance of program contents. Pilot experiences can be useful for defining large campaigns and for better estimating the material, human and financial means needed. In that respect, two examples can be cited:

- in New Zealand, a 1981 loaner program in the Dunedin area was evaluated. It increased child restraint use from 20% before the program to 60% after. As a result, the loaner program has been proposed for nationwide application (GEDDIS-APPLETON).

- in Australia, a multi media information campaign was developed from extensive motivational research, into appropriate information and communication methods. The effects of the campaign, launched in 1979, were clearly seen in the rise of restraint device sales, and the rise of restraint usage (HERBERT).

RESTRAINT USE AMONG CHILDREN

It is more difficult to describe restraint use among children than among adults. Children are not homogenous but vary widely in size. Different sizes demand different restraint systems. Children aged 10-14 years are frequently classified as adults rather than children. Furthermore the variety of methods used to protect children leads to problems in classifying children as restrained or unrestrained. Also, as restraint misuse may be a problem, restrained children should be further classified as properly or improperly restrained.

Table 7. Restraint use and legislation in different countries for children 0-15 years old.

COUNTRY	MANDATORY USE OF SEAT BELTS	MANDATORY USE OF CHILD RESTRAINTS	USAGE RATE IN %
AUSTRALIA	Yes	Yes	0-4 years 15%, in some states 50%
CANADA	1)	1)	30-60%
FINLAND	Yes if in front	Yes if in front	12%
FRANCE	No	No	10% (< 10 years in rear seat)
ITALY	No	No	<5%
NETHERLANDS	Yes if in front, 4-12 years	Yes if in front, 0-4 years	15-20%
NEW-ZEALAND	Yes, 8-14 years	No	50%
NORWAY	No	No	~10% adult belt ~25% child restraint
SWEDEN	No	No	30-40%
UNITED KINGDOM	Altern.to Child Rest. if>1 yr	Yes if in front	34% 1-4 yr 22% 5-9 yr 38% 10-13 yr
UNITED STATES	Yes in states where law includes children over 3 years	Yes if in front	40% 0-4 years
WEST GERMANY	Yes over 12 years	No	20% for smaller children

1) Different in different states. In Newfoundland children under 5 years are excluded. In Nova Scotia, New Brunswick and Ontario there are no exceptions, children 9-22 kg must use child restraints.

The quality of restraint use data cannot be judged. However, it is likely that problems of observational study validity and reliability, raised for adult restraint usage studies, also apply to children. As for adults it seems that the figures report a mix of use per number of trips and use per trip length. There are indications that the restraint use among children depends both on trip length and trip frequency. Observations made only in one type of location may therefore give biased results, even for restraint use per number of trips.

Child restraint use legislation usually does not produce usage levels as high as for adults in the front seat, though in isolated areas very high levels have been reached. In Victoria, Australia, 90% use was reached for children 0-8 years old due to legislation and campaigns (LANE). In Boston, Massachusetts, USA, children less than 1 year of age attained a usage rate of 85% (LAWLESS).

In Sweden, loaner programs have led to usage levels of almost 90% among newborn children. Generally, loaner programs seem to increase restraint use substantially.

Several studies show that restraint use is lower for older children. This could be due to the fact that information mainly affects parents of newborn children, and this information has not reached parents of older children. It is not known if parents of toddlers will continue to protect their children as they grow older.

Child restraint misuse seems to be a problem of growing interest. The most extensive studies of this problem seem to have been made in the USA and Canada, though such studies also are planned in other countries. Misuse can be divided into three different types:

- Restraint system used by a child of a size and age for which the system was not designed
- Restraint system not anchored properly to the car
- Child not anchored properly to the restraint system

The first misuse type is somewhat difficult to judge, as it is influenced by the way in which people are recommended to restrain their children and what systems are available on the market. But from different sources is is apparent that there is a tendency to use different restraint systems at too early an age and to change systems too early. This was also found by JONAH who observed very small children using only seat belts.

The second and third types of misuse are often treated together.

SHELNESS examined more than 3,000 child restraints with respect to misuse. Misuse was found to be present in 75% of the cases where both tether installation and belt route were examined. JONAH also found a high degree of misuse in connection with child safety devices. While most of the children were properly restrained in the restraint device, the device itself was often not anchored to the car properly. This means that the second type of misuse was more common than the third.

Two unpublished studies in Europe indicate that misuse also is a problem also in Europe. In Finland, 62 out of 84 children (74%) aged 0-5 years, and sitting in the restraint system were reported as misuse cases. In Sweden, TINGVALL reported 40% misuse among children in child restraints. The safety devices for small children (rearward facing child seats) did not appear to be misused to any greater extent while booster cushions were misused in more than 50% of the cases. As will be discussed below, misuse may reduce restraint effectiveness.

The following conclusions can be drawn:

- Except in the USA, restraint use among children is lower than for adults in the front seat.

- o Some countries, especially those with legislation and where special efforts have been made, show a fairly high rate of restraint use.

- o Misuse seems to be a serious problem as it is common and may decrease restraint effectiveness.

CHILD RESTRAINT SYSTEM EFFECTIVENESS

Special restraint system performance is ensured by their conformity to national standard regulations which prescribe crash simulation tests. However these experiments measure performance only within the limits of the test conditions under which they are conducted.

It is important to evaluate the actual effectiveness of restraint systems in accidents. This is more difficult for child restraints than for adults safety belts. In particular, the involvement rate of children in accidents is lower than that of adults, and the child restraint system usage rate is low in most countries.

Besides, the effectiveness evaluation can be valid only if different variables are taken into account in the analysis of accidents, especially: the age or age group of the involved child, the child's seating position in the car, the crash configuration and severity, and the restraint device type and installation (correct or not).

The small size of the samples combined with the number of variables to be analyzed make precise evaluations difficult. To address these difficulties, researchers may use different data sources. They may use:

- general accident statistics from a country. These are collected by the police. The accident informations are collected on data files of different levels: all fatal accidents, all injury accidents or tow-away accident, a limited sample representative of all accidents.

- in-depth accident investigations, which include detailed reports on vehicles and restraint devices as well as on passenger injuries.

- questionnaires mailed to the restraint device owners.

Some limitations concerning the value of these data must been kept in mind. National accidents statistics usually lack accurate and detailed information on child restraint systems and usage. Detailed accident investigations include too many severe collisions in a restricted area. Questionnaires give information on low severity collisions.

These remarks introduce the evaluation studies undertaken in each country.

1 - Evaluation in Sweden: this small country is known for its high concern about safety. Child restraint systems were introduced in cars very soon after adult three point belts. Volvo through its insurance company, has conducted accident investigations. The sample of restrained children who were involved is very small. In one analysis (NORIN), of data gathered in

1974-1975, infant restraints were carry-cots, and child restraints were mainly rearward facing seats installed either in front or in the rear. Children restrained by adult three point belts were compared with adult passengers involved in the same accidents. This analysis discussed child restraint effectiveness and found that no major injury was caused by the adult belt used by children over 5 years of age without any extra equipment. A more recent analysis (CARLSSON) is based on nearly 2000 child passengers involved in accidents. Child restraints were found to be 40% effective for moderate to fatal injuries (AIS 2 to 6).

2 - Evaluation in the United Kingdom: up to 1983, children were travelling unrestrained in the car or restrained by carry-cots (infants), bucket seats (younger children) and harnesses secured to the car by special straps. Restraint effectiveness has been evaluated from a TRRL accident sample and a questionnaire survey of KL automotive (a manufacturer of a bucket seat and a four point harness). The analysis of the questionnaire returns (663 children, primarily in low severity crashes), indicated that there was no evidence of severe neck injuries and no suggestion that deceleration forces without head contact generate major injuries (ROY). From the most serious accidents of both samples, it appeared that child restraints were proving effective in reducing injuries (LOWNE).

Legislation enacted in January 1983 has modified the way children are travelling in cars. Adult belts are used to restrain them in front, but children are more frequently unrestrained in rear seats. The figures obtained from one year of accident data collection are too small to indicate the effectiveness of the most recent restraint devices. Nevertheless, there was a marked reduction in fatal and serious injuries to large children (11-14 years) travelling in the front seat (96% were restrained by a three point belt) (LOWNE).

3 - Evaluation in France: child restraints in use since 1975, when a safety standard was enacted, are mainly carry-cots and bucket seats. An evaluation of their effectiveness was obtained from the analysis of two detailed accident investigation studies, containing data on 522 children under 10 years of age involved in accidents, with a great proportion of high severity. The analysis showed that the front seat was much more dangerous for a child than the rear seat (18% of deaths in front, 5% in the rear). Only 6 cases of restrained children were collected. The restraint devices were bucket seats but four were not of an approved type. No conclusions about child seat effectiveness can be drawn (DEJEAMMES).

4 - Evaluation in the USA: while this country as a whole can provide large accident samples, child restraint laws have been enacted state by state, with each having its own provisions. Evaluations have been conducted in a number of states from data gathered in 1975-1980 and more recently by NHTSA from national accident files (1979-1983). Children from 0 to 4 years of age were examined. Their restraint devices were rearward facing shells for infants and bucket seats with harnesses or shields for young children. The restraints were secured by adult belts (lap strap only) with additional tether straps eventually.

The different effectiveness figures are quite illustrative of the importance of variables such as crash severity, restraint system type and correct installation.

o As concerns the child's seating position, it appears from NCSAA, NASS and FARS accident files and from the accident data from 6 states gathered during the period 1970-1982 that child passengers have a significantly lower injury risk in the back seat than in the front (KAHANE). Moreover, using a restraint in the front seat or moving to the rear seat were about equally beneficial for the child (PARTYKA 1984).

o As concerns child restraint systems, there is no discussion about their effectiveness. But the benefits measured by injury reduction rates vary from one evaluation to another.

The evaluation based on accident data files from the states of New York, New Jersey, and Idaho in 1974-1978, indicated that child restraints reduced injuries by 13 to 30 percent. But these figures underestimate the potential reduction from properly used devices (KNOOP).

A statistical analysis was made of accident data files from the states of New York (1975-1978) and Maryland (1977-1980). Restraint effectiveness was derived from statistical models with control variables such as seating position, crash mode, age, and calendar year. It appeared that child restraint devices reduced fatal and serious injuries from 34 to 36 percent in each state. But the effect of improper restraint use could not be estimated (CHI).

The NHTSA files (NCSS, NASS, and FARS) were analyzed during the period 1979-1981. Child restraints were estimated to decrease the occurrence of all injury by over 80%. But the effectiveness of these restraints in preventing serious injury and fatality could not be estimated because of low restraint use and low injury rates for restrained children (PARTYKA 1983).

From the accident sampling system of North Carolina, an attempt was made to verify and supplement the investigating police reports by telephone interviews with parents of accident involved children. The study concluded that child safety seats were 80-90 percent effective in reducing fatal and serious injuries when properly used. The effectiveness dropped to 48% when improperly used (HALL).

o Concerning adult safety belt use by children, a statistical analysis (CHI) indicated that lap/shoulder belts were more effective than child restraints for children aged 1 to 4 years, but the difference is not significant. The analysis of NHTSA files (NCSS, NASS, and FARS) showed that lap/shoulder belts decrease the occurrence of injury by 60% (PARTYKA 1983).

The effectiveness of belt restraint for 5-12 year old children was analyzed from the accident files from the States of Washington, North Carolina, Maryland and Michigan; and of FARS (1977-1981). It appeared that safety belts (mainly lap belts) provide at least as much protection for the 5-12 year olds as they do for all ages (MORRIS 1983).

5 - Discussion: it must be recognized that the results of these studies may be somewhat confusing. Even if effectiveness rates cannot be ascertained because of the numerous confounding variables, it cannot be disputed that for infants and children:

o It is safer to travel unrestrained in the rear seat than in the front.

o Child restraint systems are quite effective in reducing severe and fatal injuries. The benefit appears to be very high when child restraints are properly used.

o The adult belt is effective in restraining a child in the front seat, and more effective in the rear.

However, there is still a need to investigate the effectiveness of child restraints and of child seating position, particularly concerning the following points:

o The fact that using a restraint in the front seat or moving to the rear seat could be equally beneficial should be confirmed and made precise by restraint type.

o Incorrect usage has been highlighted as a factor strongly influencing child restraint effectiveness. The method of misuse depends greatly on the restraint design, especially on the way the restraint is attached to the car. It would be helpful to relate the likelihood of a restraint's misuse to its effectiveness. This may influence safety standard regulation provisions and child restraint designs.

o Adult belts restrain children under very different conditions: lap belt only versus three point belt, children of different ages. It is necessary to know the minimum age at which a child can be safely restrained by adult belts of different types as the figures obtained up to now were based on very small samples.

o Features to make adult belts more comfortable and efficient have not yet been evaluated for children. For booster cushions, which seem to be very convenient, it would be interesting to know their effectiveness in combination with different kinds of adult belts and to investigate the difficulties encountered with different seat positions and belt anchorages.

o There have been very few attempts to analyze the injuries received by restrained children. In order to improve certain child restraint concepts and designs, it would be helpful to investigate how injury patterns are changed by the use of different child restraint devices.

CONCLUSIONS

Many countries have made and continue to make great efforts to increase their children's health by improving their safety in cars. Recommendations to seat children in rear seats of cars or to secure them in appropriate restraint systems have proven to be quite effective in reducing accident casualties.

Even if the evaluations of child restraint use and effectiveness could be more accurate, it appears that child restraint systems now available in many countries offer a high effectiveness but further efforts must be made to increase their use.

In our opinion, strategies in the future should concentrate on both restraint design and incentive programs to increase restraint use.

- Improvements in restraint design should be directed first towards easier installation in the car. The use of adult belts for securing the child restraint system may be practical. The use of additional straps should be avoided. Restraints compatible with three point belts should be available. Furthermore, acceptability by the child should be sought by improving comfort (sightseeing, posture...) and by lowering the feeling of constraint (through design of shields, harnesses...).
- Incentive programs should be financed periodically. As their advantages have been demonstrated, loaner programs should be continued not only for infants but also for older children. Information should be directed towards both parents and children.

With these efforts, it may not be unrealistic to hope that cars will be designed for integrated child protection by the year 2000.

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QUESTIONNAIRE

OECD Scientific Expert Group S3

"Effectiveness of Safety Belt Use Programs"

The OECD Group S3 seeks your assistance in answering the following questionnaire related to safety belt use, performance, and programs in your country. The information from all participating countries will be synthesized and analyzed by an international working group of rapporteurs. Their work will form the basis for a workshop on these issues in the spring of 1985. The project as a whole will assist all countries which seek improved traffic safety through increased use of occupant restraints.

Please keep the following points in mind as you complete the questionnaire.

1. All questions apply to your country only.

2. The questionnaire is divided into 6 sections: seat belt laws, seat belt usage, seat belt effectiveness, adult protection in rear seats, child restraints, and data sources. Please forward each section to the expert in your country who can best supply the information requested. Then, assemble the information from all sections and forward it to Michael Finkelstein, the United States representative.

3. Some sections ask for information about published reports (for example the seat belt usage section). Please respond for all relevant reports on the subject; reproduce as many copies of the necessary questionnaire pages as you require.

4. Some reports overlap several sections: for example, a report may contain information on seat belt use, seat belt effectiveness, and the consequences of a belt uage law. If a report contains important information for two or more areas, please supply the requested information in both questionnaire sections. If a report is primarily concerned with one area (such as effectiveness) but contains some information pertinent to another area (such as usage) then supply the requested information in the primary area and note in the "Additional comments" section that it also contains information in the other area.

5. The sections on laws, usage, and effectiveness apply primarily to adult belts in front seating positions. Child restraints and rear seating positions raise sufficiently different issues that they have separate questionnaire sections.

6. Please add other comments, suggestions, or information beyond the specific items requested that you feel to be of use.

7. Please forward the completed questionnaires and supplemental material to:

Michael Finkelstein
Associate Administrator for Research and Development
National Highway Traffic Safety Administration
400 7h Street, SW
Washington, D.C. 20590
USA

Please send all information to arrive by October 31, 1984, so that the rapporteurs may begin their work.

8. Please refer any questions on the project or this questionnaire to Mr. Claude Morin, OECD, Paris (telephone 524-8200), Mr. Michael Finkelstein, NHTSA, Washington (telephone 202-426-1537), or any project rapporteur. Our thanks in advance for your assistance.

QUESTIONNAIRE ON SEAT BELT USAGE AND USER CHARACTERISTICS

Select the published reports of seat belt usage from your country which give the best assessment of current usage, changes in usage over time and in response to legislation and other programs, and the characteristics of users and non-users of seat belts. For each report, please provide the following information.

1. Reference

- Give title, authors, affiliations and mailing address, publication date, where published:

- Please send a full copy of the report if possible.

2. Data collection

- How were the data obtained (direct observations, police accident reports, self-reported)?

- What is the time period of data collection:

- How reliable are the usage data?

- What other variables were recorded besides seat belt usage?

- For accident data:

  severity of accidents included (fatal, injury, etc.):

- For self-reports:

  how was survey conducted (interview, questionnaire, telephone, etc.):

- For observational surveys:

number of sites:

geographical area represented by sites (nation, city, etc.):

how were vehicles observed (while stopped at traffic control, observed in motion, video-taped, etc.):

3. Sample

   o how was sample selected?

   o number of observations:

   o what vehicle types are included?

   o what seating positions are included?

   o what ages are included?

4. Results

   o What proportion of vehicles studied have seat belts fitted and what types are the belts (lap, lap-shoulder):

     front seat:

     rear seat:

   o What is the overall seat belt usage observed?

- o What is the standard error of this belt usage estimate?

- o Does the report examine differences in usage by age, sex, seating position, vehicle type, time of year, day of week, time of day, location, etc.? Please indicate which are considered and summarize key results.

- o Does the report relate driver seat belt use to driver actions such as speeding, following too closely, impaired driving, use of daylight running lights, etc..? Please indicate any topics considered and summarize key results.

- o Does the report relate driver belt use to driver history (number of prior accidents or violations)? Please indicate any topics considered and summarize key results.

- o Does the report consider improper belt use (belt under arm, belt too loose, belt twisted)? Please indicate any topics considered and summarize key results.

5. Any other comments?

Completed by:

Name:

Title:

Address:

QUESTIONNARIE ON SEAT BELT EFFECTIVENESS

Select the accident data analysis reports from your country which give useful assessments of seat belt effectiveness. Effectiveness can mean either the extent to which wearing a belt reduces injury risk, all other things being equal, or the extent to which a change in the frequency of belt wearing changes the number of reported casualties. For each report, please provide the following information.

1. Reference

- Give title, authors, affiliations and mailing address, publication date, where published:

- Please send a full copy of the report if possible.

2. Accident data used

- Where and when were the data collected:

- Who collected the data (police, insurance, accident investigators):

- Size of the data set:

- Are the data from a sample or a census? If a sample, describe briefly.

3. Study scope

- Vehicles studied (years, type):

- Seating positions included:

- Occupant ages included:

- Belt usage rate in these data:

4. Analysis

   - Dependent variable used (injury criterion):

   - Describe the analysis method briefly.

   - Did the analysis control for differences in the user and non-user populations? If so, for what?

5. Results

   - Summarize the principal results.

   - Describe any major study deficiencies:

6. Any other comments?

Completed by:

Name:

Title:

Address:

QUESTIONNAIRE ON ADULT PROTECTION IN REAR SEATS

1. Requirements

- Are adults required to use belts in rear seats?

  If so:

  effective date of law:

  vehicles covered:

  occupants exempted:

2. Usage

- Estimate current adult seat belt usage in rear seat positions.

  What is the source of your estimate?

- Are there or have there been special campaigns to increase belt use in the rear seat? If so, please give brief descriptions.

3. Studies

- For any study of

  - rear seat belt use,
  - rear seat belt effectiveness, or
  - comparisons of use or effectiveness between front and rear seats, please provide

  - reference to report (title, authors, affiliations and mailing address, publication date, where published).

- brief summary of results:

- a copy of the report, if available.

4. Any other comments?

Completed by

Name:

Title:

Address:

QUESTIONNAIRE ON CHILD RESTRAINTS

1. Requirements

- Are children required by law to be restrained?
  If so:

  effective date of law:

  what restraint is required (child safety seats, belts, etc.)?

  ages affected:

  seating positions and vehicles:

2. Systems

- For the principal child safety seats in use, please:

  give a brief description (trade name, type)

  describe how installed (tether, adult belt, etc.)

  send photos if available

- Are there tests or standards for child safety seats?

  If so:

  Please state or send copies of standards or tests.

3. Use

- o Are there requirements or recommendations for child seating other than child restraints? If so, please describe briefly.

- o Current estimated child seat use:

  seats correctly installed and used:

  seats incorrectly installed or used:

- o Have there been special campaigns to encourage child seat use?

  If so, please give brief descriptions and results.

5. Studies

For any study of child seat use, child seat effectiveness, child seat use laws, or child injuries, please provide

- o references to the report (title, authors, affiliations and mailing address, publication date, where published):

- o a brief summary of results:

- o a copy of the report, if available.

6. Any other comments?

Completed by:

Name:

Title:

Address:

QUESTIONNAIRE ON DATA SOURCES

Select the data files available in your country which can be used to investigate belt effectiveness, belt use, or belt user characteristics. Files must be accessible to OECD either directly or through questions posed to those who maintain the file. For each, provide the following brief description.

- Brief file name:

- Person to contact for information and documentation (name, title, address telephone):

- Type of data (accident, observation, interview, etc.):

- Where and when collected:

- By whom collected (police, insurance, accident investigators, others):

- Belt use rate (or range:)

- Number of observations:

- Key variables present:

- Key variables not present:

- Uses in the context of this project:

- Major strengths:

- Major weaknesses:

Completed by:

Name:

Title:

Address:

QUESTIONNAIRE ON SEAT BELT LAWS

1. FROM AVAILABLE SOURCES WE HAVE COMPILED THE FOLLOWING INFORMATION ON YOUR JURISDICTION'S SEAT BELT LAW. PLEASE CONFIRM OR CORRECT THE INFORMATION BELOW AND ADD NEW OR MISSING INFORMATION.

JURISDICTION COVERED BY LAW:

DATE LAW EFFECTIVE (MONTH/YEAR):

VEHICLES COVERED:

OCCUPANTS OR SEATING POSITIONS EXEMPTED:

ROADS COVERED:

PENALTIES AUTHORIZED:

FINES:

IMPRISONMENT:

REDUCED CRASH VICTIM COMPENSATION:

OTHER:

2. HOW IS LAW ENFORCED?

A) WHEN STOPPED FOR ANOTHER PURPOSE ______
B) DIRECTLY (STRICT) - WHEN OBSERVED NOT WEARING BELT ______
C) WARNED - ONLY REQUESTED TO BUCKLE UP BY OFFICER ______
D) OTHER (SPECIFY)

3. IS ENFORCEMENT OF THE LAW A RESPONSIBILITY OF NATIONAL OR LOCAL POLICE AUTHORITIES? IF BOTH, PLEASE PROVIDE AN ESTIMATE OF THE PROPORTION OF TOTAL ENFORCEMENT ACTIONS TAKEN BY EACH OF THE TWO JURISDICTIONAL LEVELS.

4 WHAT ARE THE TYPICAL PENALTIES IMPOSED FOR VIOLATION OF THE LAW?

5. HOW EXTENSIVE IS ENFORCEMENT? PLEASE PROVIDE FIGURES (ESTIMATES IF NECESSARY) ON THE FOLLOWING:

A) NUMBER OF WARNINGS/YEAR ______
B) NUMBER OF TICKETS/YEAR ______
C) TOTAL NUMBER OF TICKETS/YEAR FOR ALL TRAFFIC OFFENSES ______

6. DESCRIBE ANY SIGNIFICANT CHANGES MADE IN THE LAW SINCE ITS INCEPTION. ARE ANY PROPOSED CHANGES NOW PENDING?

7. WHAT OTHER MAJOR EFFORTS TO SUPPORT OR IMPROVE THE LEVELS OF SEAT BELT USE HAVE BEEN UNDERTAKEN?

A) SPECIAL ENFORCEMENT MEASURES, BLITZES, TICKET QUOTAS, ETC. (PLEASE SPECIFY TYPE AND NUMBER)

B) SPECIAL PUBLIC INFORMATION CAMPAIGNS (PLEASE SPECIFY TYPE, NUMBER AND EFFECTIVENESS [IF KNOWN]).

C) OTHER (SPECIFY).

8. HAS THE IMPACT OF THE LAW ON USAGE RATES BEEN EVALUATED? IF SO, PLEASE GIVE REFERENCES. WHAT WAS THE USAGE RATE PRIOR TO THE LAW, ONE YEAR LATER, AND CURRENTLY?

9. ANY OTHER COMMENTS?

COMPLETED BY:

NAME: ______________________________
TITLE: ______________________________
ADDRESS: ______________________________

AGENDA

WORKSHOP ON
EFFECTIVENESS OF SAFETY BELT USE LAWS:
A MULTI-NATIONAL EXAMINATION
WASHINGTON, D.C. (U.S.A.)

TUESDAY, NOVEMBER 12, 1985

WELCOME: Elizabeth Hanford Dole
Secretary, U.S. Department of Transportation

OPENING REMARKS: Burkhard Horn -- OECD

PROJECT DESCRIPTION:
Michael M. Finkelstein, Chairman -- OECD Working Group

SESSION 1 -- SAFETY BELT USE LAWS

Chairman -- T. Vaaje -- Norway
Discussion Leader -- B. O'Neill -- U.S.A.

Working Paper Presentation -- SAFETY BELT USE LAWS
T. Vaaje -- (30 minutes)

DISCUSSANTS:

P. Milne	Australia
H. Warnke	Germany
E. Petrucelli	U.S.A.

General Discussion

LUNCHEON
Speaker -- Peter Kissinger, Managing Director,
National Transportion Safety Board

SESSION 2 -- SAFETY BELT USE RATES

Chairman -- E. A. Marburger -- Germany
Discussion Leader -- J. Nichols -- U.S.A.

Working Paper Presentation -- SAFETY BELT USE RATES
E. A. Marburger -- (20 minutes)
J. A. Lawson -- (20 minutes)

DISCUSSANTS:

H. Knoflacher	Austria
S. Lassarre	France
M. Dale	United Kingdom
N. Hatfield	U.S.A.

General Discussion

WEDNESDAY, NOVEMBER 13, 1985

SESSION 3 -- CASUALTY REDUCTIONS RESULTING FROM SAFETY BELT USE LAWS

Chairman -- J. Hedlund -- U.S.A.
Discussion Leader -- B. Campbell -- U.S.A.

Working Paper Presentation -- CASUALTY REDUCTIONS
J. Hedlund -- (20 minutes)
Working Paper Presentation -- BRITISH EXPERIENCE
B. Sabey -- (20 minutes)

DISCUSSANTS:

W. Rutherford	Northern Ireland
B. Aldman	Sweden
J. Versace	U.S.A.
A. Wagenaar	U.S.A.

General Discussion

SESSION 4 -- REAR SEAT BELT USE AND CHILD RESTRAINT ISSUES

Chairpersons -- M. Dejeammes -- France
& C. Tingvall -- Sweden
Discussion Leader -- S. Wilson -- Canada

Working Paper Presentation -- REAR SEAT BELT USE
C. Tingvall & A. Nygren -- Sweden -- (20 minutes)

DISCUSSANTS:

J. Christensen	Denmark
H. Norin	Sweden
L. Smith	U.S.A.

General Discussion

Working Paper Presentation -- CHILD RESTRAINTS
M. Dejeammes -- (20 minutes)

DISCUSSANTS:

B. Sabey	United Kingdom
C. Kahane	U.S.A.
E. Weinstein	U.S.A.

General Discussion

THURSDAY, NOVEMBER 14, 1985

CONFERENCE SUMMARY:
M. Finkelstein, Chairman

Discussion Leaders' Summary of Sessions I - IV
SESSION I -- B. O'Neill
SESSION II -- J. Nichols
SESSION III -- B. Campbell
SESSION IV -- S. Wilson

Panel of OECD Working Group Members to Discuss:
Future Research Agenda on Safety Belt Use Issues

PANEL MEMBERS:

- B. Sabey
- J. Hedlund
- J. Lawson
- E. Marburger
- A. Nygren
- C. Tingvall
- T. Vaaje

LUNCHEON
Speaker -- Diane K. Steed, Administrator
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